

A SYSTEM FOR MONITORING IMPACT OF DENALI NATIONAL PARK ROAD
TRAFFIC ON WILDLIFE

by

Dale L. Taylor

U.S. Geological Survey
Biological Resources Division

Kenneth D. Vogt

U.S. Geological Survey
Biological Resources Division

and

Janet Warburton
National Park Service
Alaska Regional Office

United States Geological Survey
Biological Resources Division
Alaska Biological Science Center
10 11 East Tudor Road
Anchorage, Alaska 99503

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INTRODUCTION

Denali National Park and Preserve (DENA) is a 6.03 million acre reserve lying between Anchorage and Fairbanks, Alaska. The park was established in 1917 as a wildlife refuge, and is managed to maintain the wilderness character. With the highest mountain in North America, Mt. McKinley, and the easy availability of wildlife for viewing, the park is Alaska's most favored destination point. From 1972 through 1984, visitation grew from 88,615 to 394,426 visitor days per year (GMP, 1986), and then increased by 50,000 per year to 596,000 visitors in 1988. This demand for motorized access to the park, especially along the 92.5 mile-long park road, has resulted in controversy and claims of traffic disturbance to wildlife [(letter from Superintendent, DENA July 13, 1988) (Anchorage Daily News, May 14, 1995; May 26, 1995; February 5, 1996; June 18, 1996) Leo (1987); Lee Rue (1996)].

To assess these changes, the Superintendent requested the wildlife road monitoring program reported here (letter from Superintendent, DENA 2/2/1987).

The objectives of this study are to establish a monitoring program to detect changes in the number of moose (*Alces alces*), grizzly bears (*Ursus arctos*), Dall's sheep (*Ovis dalli*), caribou (*Rangifer tarandus*), and wolves (*Canis lupus*) observed by visitors. Bus drivers were observers, recording the location, number, and sex and age of animals observed by park visitors on the daily trips into the park. The database would thus establish a baseline for monitoring long term trends in the number of animals observed along the park road.

The Denali Park Road.

The only major access into the area is the 92.5 mile (148 km) Denali Park Road, constructed in 1938 (Fig. 1). The road begins at the park boundary, near headquarters, and terminates at private inholdings near Kantishna (Fig. 1). The road was open to park visitors and for access to the Kantishna area, from the 1938 completion until 1972. During this period, the only access to the road was via the Alaska Railroad. When the George Parks Highway was completed in 1972, the new route provided access to the park entrance. Travelers from Anchorage to Fairbanks now had easy access to the Denali road, and a dramatic increase in vehicle traffic resulted. Because of concern for wildlife, the Denali road was closed to public travel in 1972 from mile 12.8 to the

end at Kantishna. A free bus transportation system was then established along with fee concession tour buses to carry visitors into the park. During the last few days prior to winter closure, a lottery is held where winners are provided private vehicle passage for the entire length of the road. Travel permits are issued for limited private vehicle access to Kantishna during the season the road is open.

The park road is described by "milepost,"; for example, the park entrance is milepost 0.0, Denali Park headquarters 3.42, Teklanika River Bridge at 31.28, etc. Frequently referenced points are shown in Table 1. A detailed listing and description of mileposts is in Appendix I.

This text describes road conditions as they occurred in 1989 and 1990. For example, road closure was moved to the Savage River Bridge at milepost 14.8 in 1991.

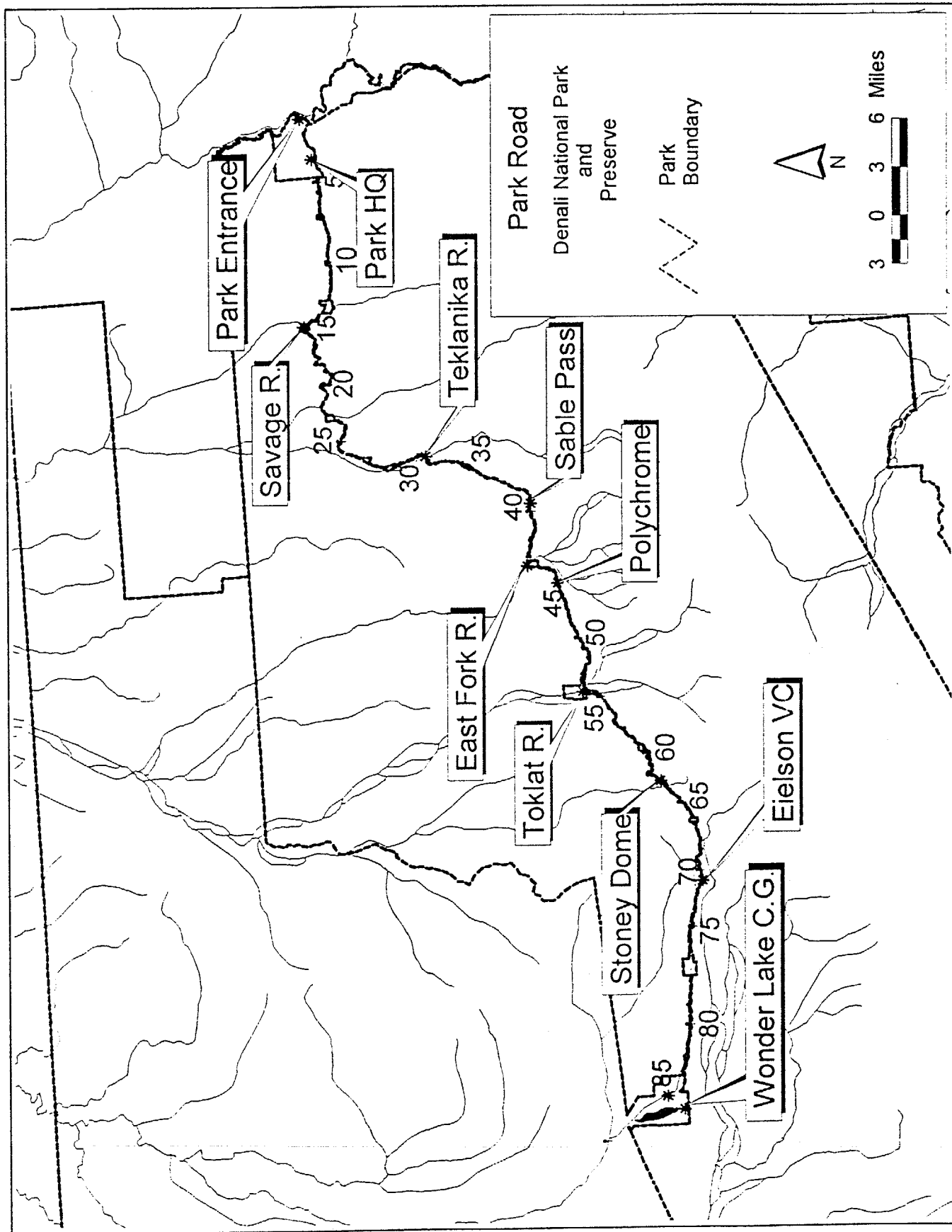


Figure 1. Map of the Denali National Park and Preserve Road.

Table 1. Mileposts and selected landmarks along the Denali Park Road.

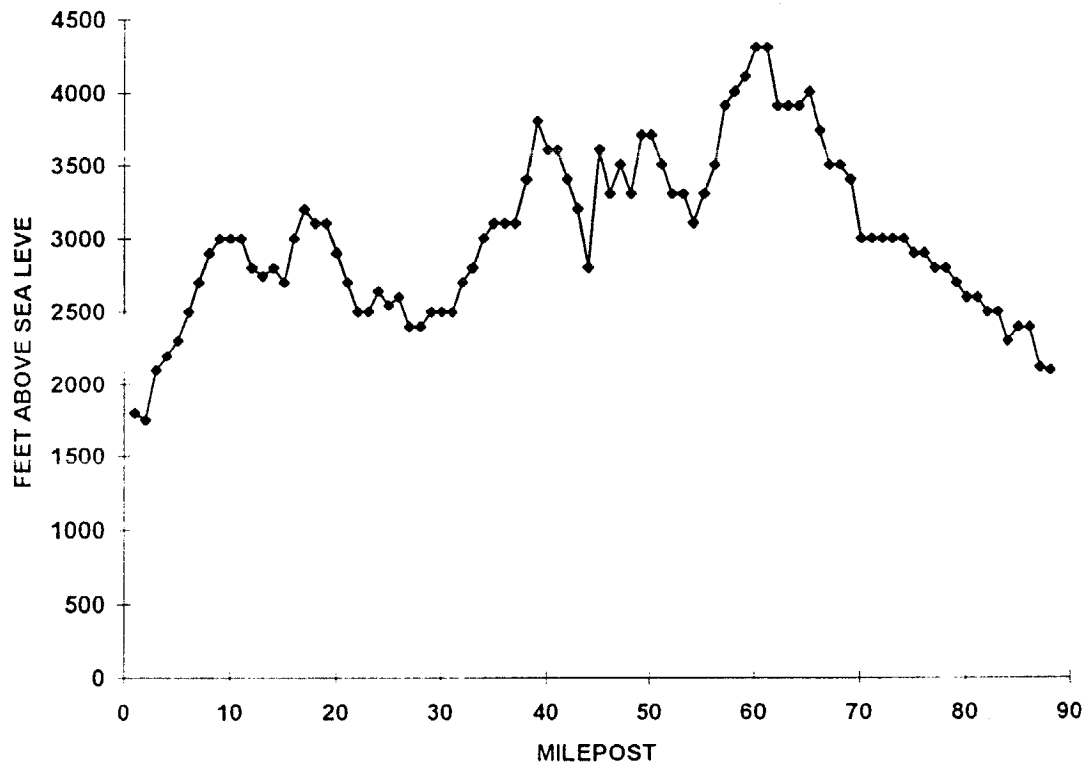
MILEPOST	LANDMARK
0.00	Park Entrance
2.10	Ascending Grade
3.31	Rock Creek Bridge
3.42	Denali Headquarters
14.80	Savage River Bridge
22.77	Sanctuary River Bridge
30.36	Gate
31.28	Teklanika River Bridge
34.07	Igloo Creek Ranger Station
39.12	Sable Pass
43.35	East Fork Toklat River Bridge
45.93	Polychrome Pass
53.15	Toklat River Bridge
61.87	Summit Stony Hill
66.03	Eielson Visitor Center
86.70	Wonder Lake Campground
92.50	Kantishna

The first 14.8 miles of the road are paved and the remainder, a gravel surface. The road is open without permit to the general public to milepost 12.8 allowing access to clustered park facilities including employee housing and maintenance buildings. From milepost 12.8 to the end, the road is restricted to a fixed number of private vehicles, tour and shuttle buses, and National Park Service (NPS) vehicles to reduce impact on wildlife found along the road. For a detailed discussion of the park road, see Brown (1991), NPS (1988), NPS (1979), NPS (1994), and (Heacox 1986).

Elevation varies from approximately 1,700 ft (518 m) near the park entrance to a maximum level of 4,300 ft (1311 m) at milepost 60. There is considerable variation in elevation along the park road as illustrated in Figure 2.

Vegetation maps are being developed for DENA, but they were not available for this study.

Fig. 2. Elevations (feet) at mileposts on the Denali park road.



Visitor Season.

Weather determines length of the visitor season. The park road opens as soon as NSP removes the snow and completes maintenance, usually the latter part of May. Snowfall determines road closure, usually about mid-September.

Weather data, recorded at Park Headquarters, mile 3.42, was summarized for 1989 and compared to the long term record. Weather records were not available for higher elevations along the road where wind chills and more severe weather would be expected within the park.

Maximum temperatures occurred during the first week of July when a temperature of 81°F(27.2°C) was recorded (Fig.3). A maximum daily temperature of 41°F (5°C) occurred during mid-September.

Temperatures at or below freezing occurred each month of the summer (Fig. 4). The lowest temperature recorded during the summer months was 19°F (-7.2°C) on September 16. Both maximum and minimum temperatures were slightly warmer during 1989 compared to the long term record (Figs. 3a & 4a).

Fig. 3. Maximum temperature (°F) and date of occurrence, 1989.

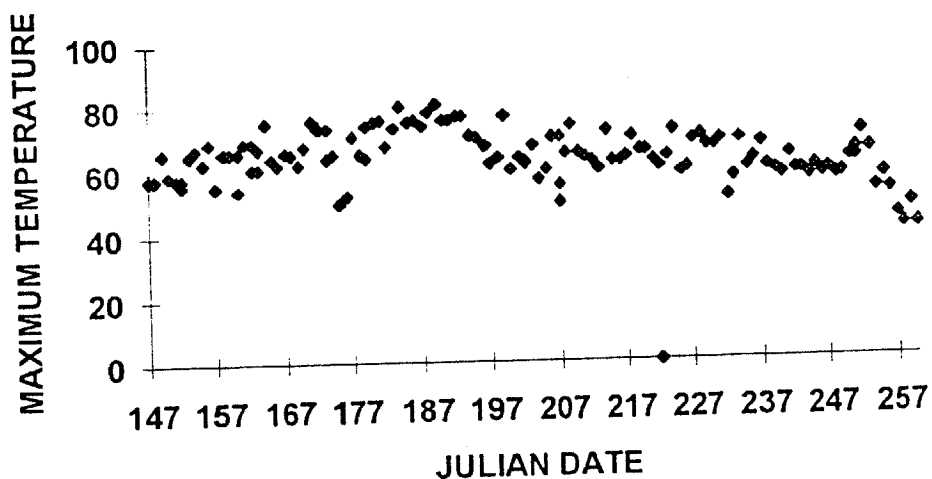


Fig. 3a. Mean maximum temperature (°F) May through September, 1989, and long term (1925-1993).

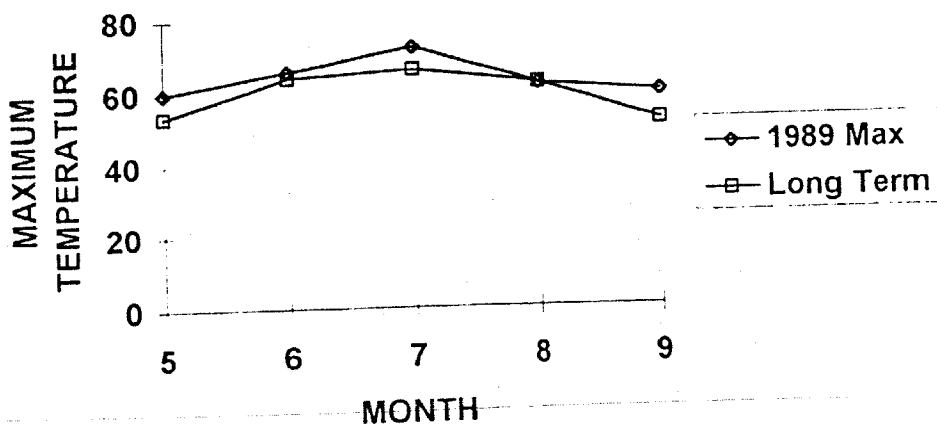


Fig. 4. Minimum temperature ($^{\circ}\text{F}$) and date of occurrence, 1989.

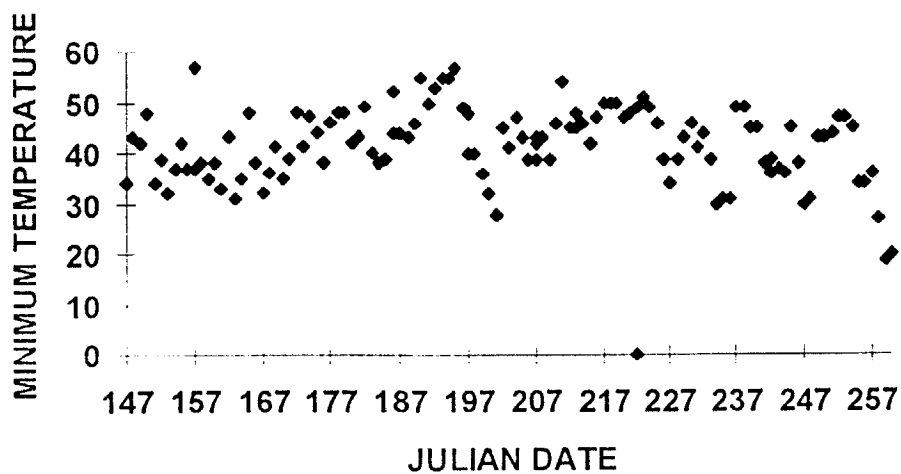
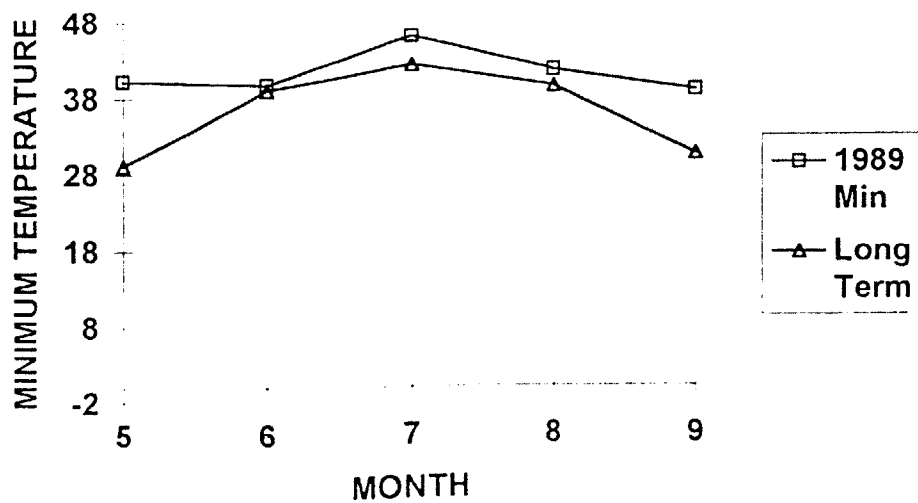


Fig. 4a. Mean minimum temperature ($^{\circ}\text{F}$) May through September, 1989 and long term (1925-1993).



Traffic Levels.

The NPS established traffic levels for the road in 1936 in the General Management Plan (GMP) (NPS 1986). The philosophy of the GMP is to allow as many people as possible to see Alaskan wildlife in their natural habitat. The objective of the GMP is to increase visitor use of the bus systems and reduce private vehicles on the road. Buses can carry up to 50 people compared to 4-6 in the average private vehicle. Animals are more visible from buses because people sit higher off the ground and can easily see over vegetation along the road edge. Singer and Beattie (1986) demonstrated activities along the park road associated with the private vehicle, such as stopping at will, making noise getting in and out of a car, and approaching animals on foot, cause the greatest disturbances to wildlife. In contrast, visitors riding buses are not allowed to leave vehicles in areas of critical wildlife habitat.

According to the GMP, traffic levels were to be reduced in three stages (NPS 1986). During stage one, total bus traffic was to be held to the 1984 monthly averages plus 15% allowing bus service to fluctuate with daily visitor demand. Private vehicle traffic, meanwhile, was to be reduced by making all the interior campgrounds accessible only by shuttle bus. During stage two, bus traffic was to be held to 1984 annual levels plus 15%. NPS travel was to be reduced. During stage three, after total traffic levels were reduced, bus traffic was to be allowed to increase to a level that did not unacceptably affect wildlife behavior (NPS 1986, p. 15). Comparison of data for 1984, the proposed full implementation of the GMP, and recorded levels for 1988 and 1989 show objectives, except NPS vehicles, were achieved (Table 2).

Table 2. Traffic levels in 1984, at proposed full implementation of the traffic plan, and as recorded in 1988 and 1989.

VEHICLE TYPE	1984*	FULL*	1988	1989
Tour and Shuttle Buses	4,245	5,094	4,436	5,428
Private Vehicles	6,662	3,664	3,516	4,454
NPS Vehicles	1,754	1,754	1,412	1,861
Total	12,661	10,512	9,364	11,743

***Denali National Park General Management Plan**

(NPS 1986)

METHODS

After examining a large number of parameters, specific ones were chosen to use in monitoring disturbance to park wildlife by vehicle traffic. Bus drivers assisted in developing data forms and were trained in use of a rangefinder for measuring distance. A system was tested where drivers made observations as they drove visitors over the park road at various times of the day, during various weather and road conditions, and driving buses representing the types of transportation used in the park.

This report presents results from driver observations. Different data types and summaries are presented for consideration by park management. We did not measure scenic values, aesthetics, impact of road dust, and other factors that could contribute to visitor satisfaction. Harrison (1975) and Singer and Beattie (1986) surveyed park visitor attitudes in 1972-1973 when the system was established, and after it had been in effect for 10 years. Harrison (1975) found the vast majority of people who visited the park approved of the transportation policy. Residents of Alaska gave a lower approval rating. Singer and Beattie (1986) found approval for the NPS mandatory transportation system increased 17% from 1972 surveys compared to 1982, and further increased 4% from 1973 to 1983 surveys.

Previous park road studies include work by Tracy in 1973 and 1974 (Tracy 1977), Singer and Beattie in 1982 and 1983 (Singer and Beattie 1986), and Looney (1992). Looney (1992) reported on observations recorded in 1980-1984, 1987, 1989, and 1990. These studies differed in that intensive work was done by a single observer, and/or observers recording observations both going into the park and on the return trip.

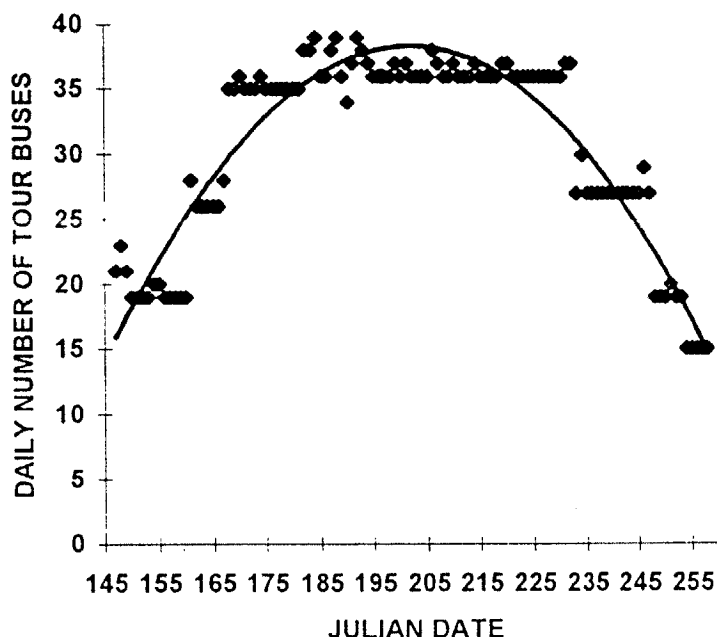
The Bus Systems

Two bus systems operate within DENA: (1) The DENA Shuttle Bus System, and (2) the Tour Bus System. The systems have totally different objectives and, therefore, were recorded separately. In addition to the two park bus systems, private lodges operate during the summer season near Kantishna. Guests arrive via lodge vehicles driven on the park road, via plane to Kantishna, or on shuttle buses. An example is Camp Denali Lodge, where passengers board a small bus near park headquarters for a leisurely drive to Camp Denali at the end of the park road. The drive is billed as a wildlife tour and is part of the package offered by the Lodge. Time is taken to search for, and observe, wildlife during the trip. Two Camp Denali drivers participated in this study during 1988 as a part of this study. Their results will be reported in a separate paper.

The two NPS sponsored bus systems are:

DENA SHUTTLE BUS SYSTEM. In 1973, the NPS instituted a mandatory system of free shuttle buses (Singer and Beattie 1986). The rented school buses function as a scheduled transportation system from point to point along the park road. Stops are made to view wildlife, to drop off, or to pickup passengers who may have been hiking, or who wish to hike, take photographs or to access a campground. Buses are operated from Memorial Day until the end of the season, about September 15, depending upon weather conditions. Round trips are driven each day, often from Riley Creek to Elision Visitor Center, or Wonder Lake (Fig. 1). The daily number of trips is shown in Fig 5.

Fig. 5. Daily number of shuttle bus trips, Denali National Park and Preserve, 1989.



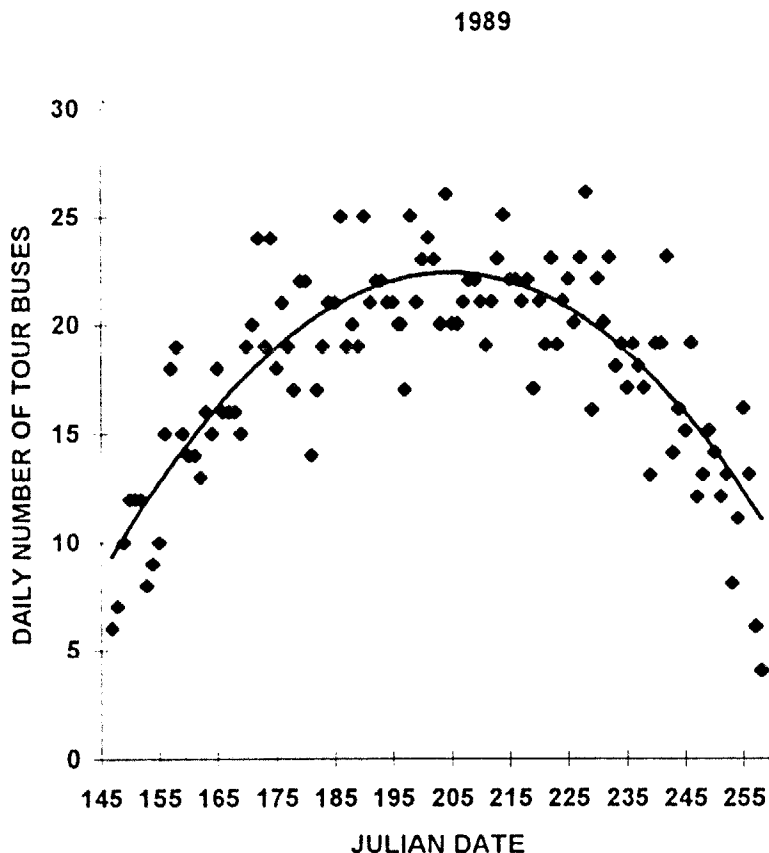
TOUR BUS SYSTEM. A private concessionaire operates fee tour buses that stop for passengers at lodges outside the park or at the park hotel. Round trips are driven each day from these locations to Toklat or Stony Hill Overlook (Fig.1). These buses follow a rather loose schedule which allows passengers to linger longer than those on shuttle buses during wildlife observations. Each driver provides an amplified running commentary on natural history. Lunch is provided prior to making the return trip. The daily number of trips is shown in Fig. 6.

DRIVER OBSERVERS We selected drivers as observers for this study from both the bus systems. Drivers were selected based upon their interest in the project, their background, and length of time driving the park road.

Fifteen shuttle and tour drivers participated in the study from 1988-1991 (Table 3). Three drivers participated all 4 years. A 1988 questionnaire revealed driver observers had been in the Denali area an average of 6.0 years, and had been driving in Denali an average of 5.4 years. Six, of ten reporting, had Bachelor of Science/Arts degrees, one a Master of Arts degree, one an Associate Arts degree, and two did not report college degrees. In sum, the driver observers were highly experienced

and educated in the work of driving and observing wildlife along the park road.

Fig. 6. Daily number of tour buses, Denali National Park and Preserve, 1989.



Data Collection and Analysis

We provided an experimental data form to each selected driver for trial. We then modified the form according to their comments, time constraints, and concerns for safe driving and safety of passengers (Shearer 1988). A sample data form is shown as Appendix 2.

Observers collected data from a starting point at or near the park entrance until the bus turned around for the return trip. No data were collected on the return trip, because stops were

made less consistently, and many passengers slept. We felt this method was more easily repeated compared to Tracy (1977), Singer and Beattie (1986), and Looney (1992) who collected data the full length of the trip.

The driver/observers stopped the bus at each animal sighting to provide passengers the best possible viewing opportunity. During the stop, observers recorded the bus odometer reading to the tenth of a mile (with the animal perpendicular to the road), species present, number of adult, young, or unknown sex/age of animals, estimated or measured with a rangefinder animal distance from the road, the side of the road the animal was located, and pertinent remarks. Data sheets were collected daily as the bus returned to the Savage River Check Station. The DENA Concessions Specialist checked all data sheets for completeness, and contacted observers for details in those rare cases when the information was missing. Only one data sheet was discarded for 1988, and none for 1989. An occasional record with a distance over 87 was observed due to drivers recording information on the return trip, or due to an error in the vehicle odometer. During analysis, records were truncated at milepost 87.

We made the decision to use bus drivers as observers in late May, 1988. The system was developed during June, and data were collected from July 1 through September 14, 1988. Distances were estimated from July 1 to August 15. At that time each driver was provided a rangefinder and trained in its' use. From August 15, 1988, throughout the rest of the study, distances were measured in 10-m intervals to 100-m and 100-m intervals beyond 100-m (see Appendix 2).

Data were collected the following dates:

1988	July 1 (Julian day 182)	-September 16 (Julian day 259)
1989	May 27 (Julian day 147)	-September 17 (Julian day 260)
1990	May 23 (Julian day 143)	-September 24 (Julian day 267)
1991	May 25 (Julian day 145)	-September 14 (Julian day 257)

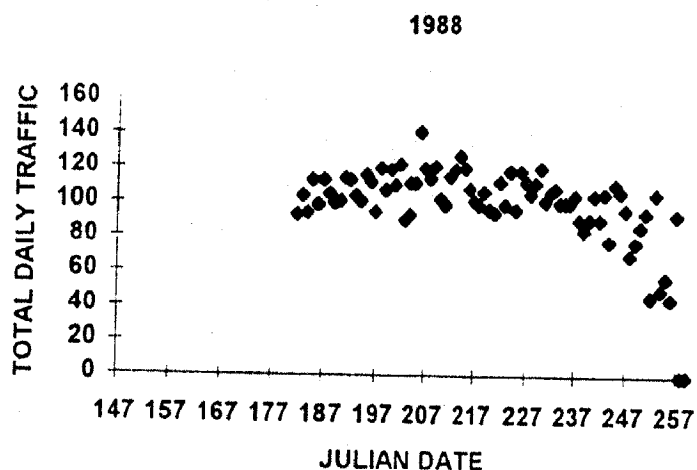
A Julian date calendar is included in Appendix 2.

A few drivers from the 1988 and 1989 seasons voluntarily collected data during 1990 and 1991.

Bus system managers established the time driver observers departed for the daily trip. Interest in conducting the study was considered a higher priority than time of bus departure, therefore, more results were reported at certain specified hours. Drivers were limited to driving 5 days per week. For analysis, start time was considered to be within 60 minute times of whole hours. For statistical purposes, times were lumped as follows: 500 am-800 am, 900 am-1400 pm, and 1500 pm -1800 pm.

NPS personnel at the Savage Creek Check Station record traffic counts. They keep a record of each vehicle and type that enters the park. Traffic counts included the number of tour buses, shuttle buses, NPS vehicles, number of private vehicles, including those going to Kantishna lodges, and the number of photographers. Total of all daily traffic was summed and is shown in Figs. 7 and 8 for 1988 and 1989.

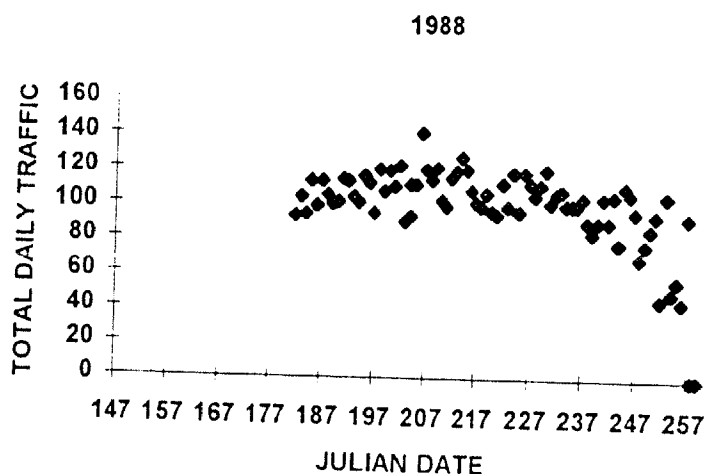
Fig. 7. Total daily traffic for 1988.



The NPS limits the number of private vehicles on the park road until near the close of the season in mid-September. The last week-end before closure of the road for winter, the NPS opens the road to persons driving private vehicles who have won the right to do so through a lottery system. The number of private vehicles increases for this limited time from approximately 40 per day to approximately 180 per day (Fig. 9).

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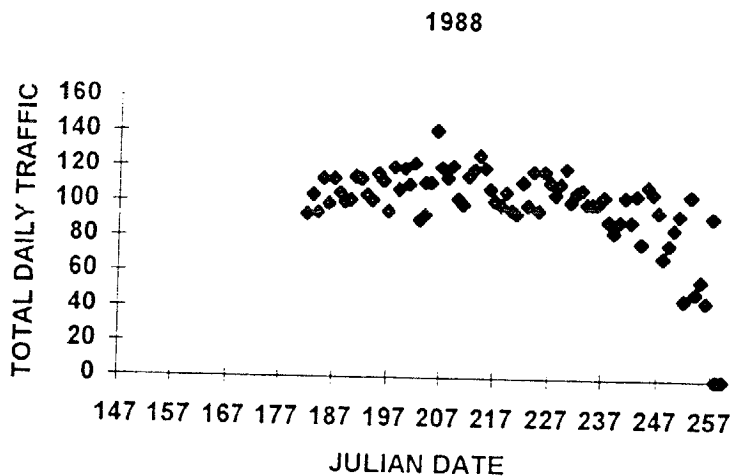
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Fig. 8. Total daily traffic for 1989.

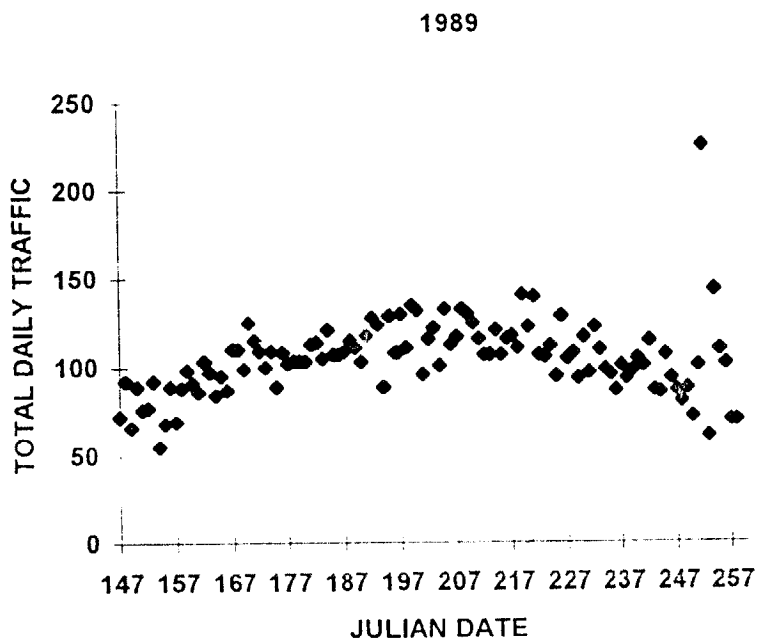
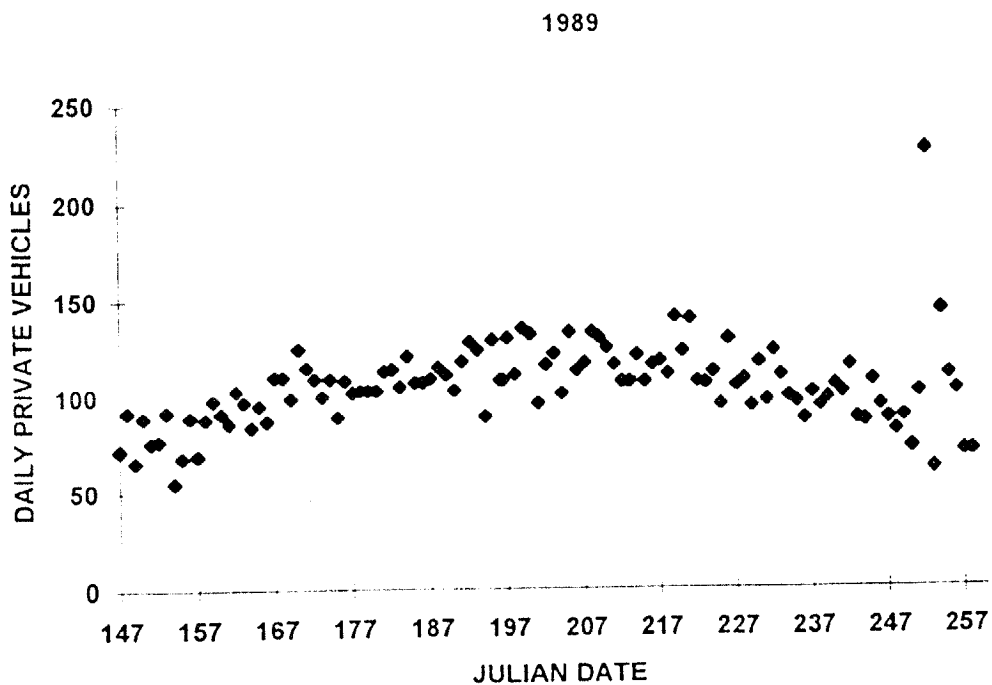


Fig. 9. Number of private vehicles allowed access to the Denali Park Road on a daily basis, 1989.



Data were collected from July 1 (Julian date 182) until the last bus run on September 16 (Julian date 259), 1988. Concern that animals, present in the early season, and not habituated to human activity, are possibly driven away by road traffic, led to monitoring a full season, May 27 (Julian date 147)-September 17 (Julian date 260), 1989. Drivers continued the study during 1990 and 1991, collecting data from May 23 (Julian date 143) through September 17 (Julian date 260) and May 23 (Julian date 143) through September 14 (Julian date 257), respectively. Data were entered in dBase III+ format for descriptive analysis (see Appendix 2). We presented the Denali Road monitoring system to Denali National Park Resources Management in early May 1991 (Fig. 10) for implementation as an annual operational procedure.

Park management requested data be analyzed by "management units" as follows(letter from Superintendent Martin to Dale Taylor dated 14 December 1995):

LOCATION	MILEPOST
George Parks Highway to Savage River.....	0-15
Mile 17 to Teklanika Rest Stop.....	>15-30
Teklanika Rest Stop to Toklat.....	>30-54
Toklat to Stony Overlook.....	>54-62
Stony Overlook to Eielson Visitor's Center.....	>62-66
Eielson to Wonder Lake Ranger Station.....	>66-87

N2219

June 18, 1991

Memorandum

To: Dale Taylor

From: Jeff Keay

Subject: Denali Road Survey

Enclosed is a copy of the "new" observation form. As you can see there are no real changes. We are not asking for new behavioral information either. We had 4 tour drivers at one time but 2 quit. Pat is working with Dominic to get 2 to 3 more.

Thanks for your advise.



P.S. THE REAL FORMS ARE STILL ON COLORED PAPER.

RESULTS

OBSERVATION TRIPS AND RECORDS OF ANIMAL SIGHTINGS

Equal numbers of shuttle and tour drivers participated in 1988 and 1989 when the project was being developed. Two tour drivers, both of whom had been observers during the previous 2 years, and two new tour drivers collected data during 1990 and 1991. No shuttle drivers collected data during 1990, thus data from mile 62-87 are lacking for that year. Two shuttle drivers volunteered during 1991. As noted above, 2 Camp Denali drivers participated during 1988. Their results will be reported in another summary.

The total number of shuttle trips varied from 2,943 to 3,419 during the 1988 and 1989 seasons (Table 3). The number of trips, where records were kept, totaled 244 (8% of all shuttle trips) in 1988, and 216 (6% of all shuttle trips) in 1989.

Total number of tour bus trips varied from 1493 to 2009 during the seasons of 1988 and 1989 (Table 3). Tour drivers made observations on 294 (19.6% of tour trips) of the trips during 1988, and 266 of the 2009 (13.2% of all tour trips) trips during 1989.

The number of observation trips varied between drivers from < 10 to \leq 85 trips during any one season (Table 3). The volumes of data resulting from the 14 drivers in 1988 resulted in the decision to reduce the number of drivers reporting results to a more manageable level. Hence, nine drivers were used in 1989. Results reported are from a total of 1,475 bus trips during the 4 years.

Table 3. Number of observation trips by drivers and bus type each year.

Driver	Year		Year		Year		Year	
	1988		1989		1990		1991	
	Shuttle	Tour	Shuttle	Tour	Shuttle	Tour	Shuttle	Tour
1	53		66					
2	44		35					
3	42		56					
4	48		10					
5	32		49					
6	25							
7		43						
8		52		59				
9		52						
10		56		85		82		83

Table 3. Number of observation trips by drivers and bus type each year.

Concluded.

11		44		51		68		73
12		47		71		43		
13	*							
14	*							
15						52		
16							18	
17							36	

Total

Drivers	6	6	5	4	0	4	2	2
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Total

Trips	244	294	216	266	0	245	54	156
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Total

Season	538*		482			245		210
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TOTAL NPS

BUS TRIPS	2943	1493	3419	2009	**	**	**	**
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* Includes two drivers from Camp Denali (2 and 8 trips respectively).

**Totals were not completed.

The number of bus trips measured varied between years and months, depending upon the opening and closure of the season (Tables 4-7). Full months of observation, June, July, and August, varied from 232 trips, in July 1988, to 57 trips in June 1991. Fewer trips were made during May at the opening of the season and during September before the season closed. The majority of the buses left for the day at 0600 and 0700 hrs (Tables 4-7). Afternoon departures during the 1500 hr approximated the number of departures at the 700 hr (Tables 4-7). Buses left at various other times as shown in Tables 4-7 and Fig. 11 for 1988 and Fig. 12 for 1989.

Fig. 11. Time and date observation buses departed, 1988.

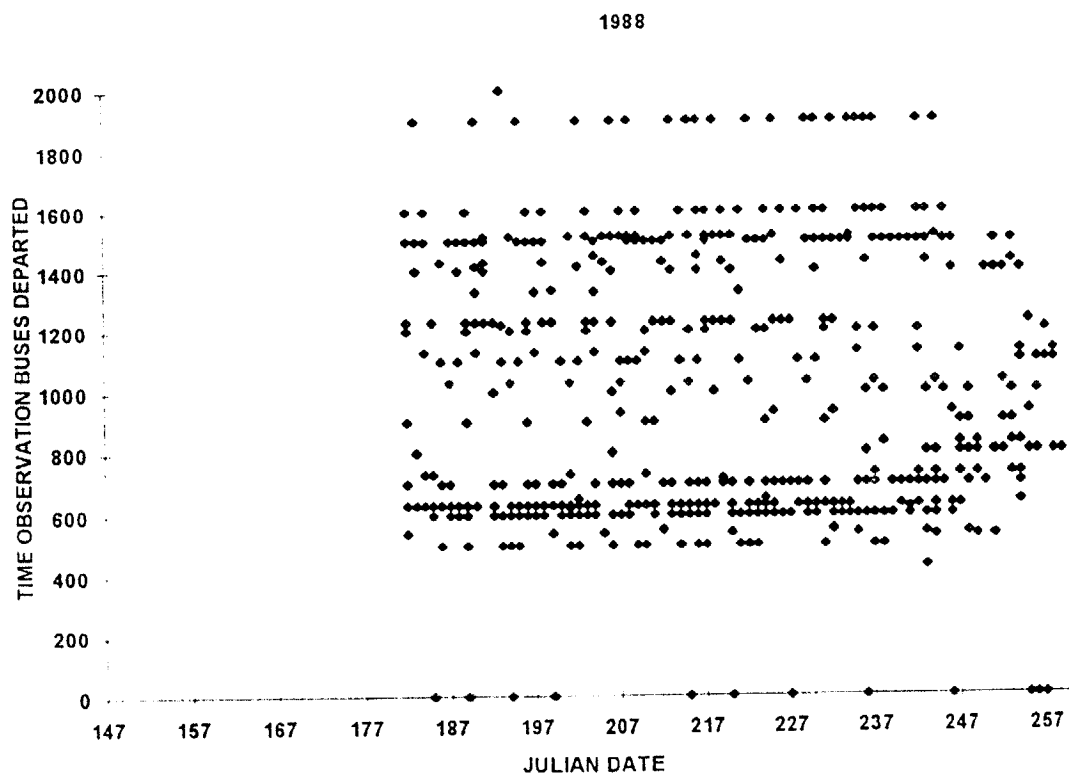


Fig. 12. Time and date observations buses departed, 1989.

1989

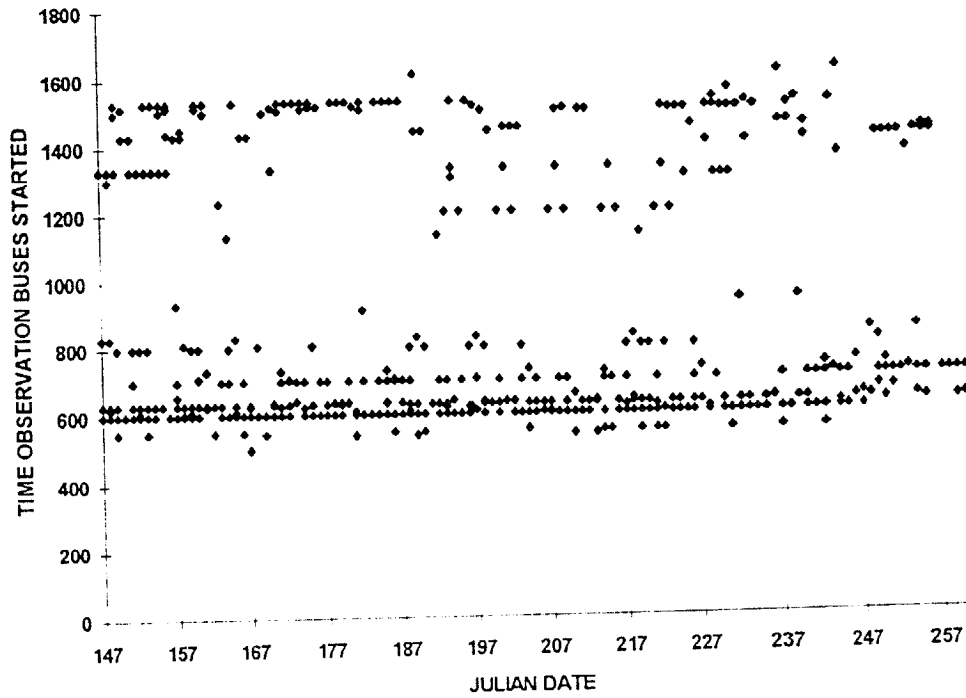


Table 4. Number of trips measured by hour and month for 1988.

HOUR	MONTH			TOTAL
	JULY	AUGUST	SEPT	
500	17	14	4	35
600	73	66	6	145
700	23	39	14	76
800	2	3	16	21
900	7	4	7	18
1000	6	9	6	21
1100	15	7	7	29
1200	21	18	2	41
1300	5	1	0	6
1400	13	10	7	30
1500	34	28	7	69
1600	9	17	1	27
1700	0	0	0	0
1800	0	0	0	0
1900	6	14	1	21
2000	1	0	0	1
TOTAL	232	230	78	540

Table 4. Number of trips measured by hour and month for 1988.

HOUR	MONTH			TOTAL
	JULY	AUGUST	SEPT	
500	17	14	4	35
600	73	66	6	145
700	23	39	14	76
800	2	3	16	21
900	7	4	7	18
1000	6	9	6	21
1100	15	7	7	29
1200	21	18	2	41
1300	5	1	0	6
1400	13	10	7	30
1500	34	28	7	69
1600	9	17	1	27
1700	0	0	0	0
1800	0	0	0	0
1900	6	14	1	21
2000	1	0	0	1
TOTAL	232	230	78	540

Table 5. Number of observation trips measured by the hour and month, 1989.

HOUR	MONTH					TOTAL
	MAY	JUNE	JULY	AUGUST	SEPT	
500	4	7	5	9	0	25
600	17	77	72	64	15	245
700	4	16	20	19	19	78
800	0	9	8	6	3	26
900	0	1	1	2	0	4
1000	0	0	0	0	0	0
1100	0	1	1	1	0	3
1200	0	2	6	4	0	12
1300	0	7	4	8	2	21
1400	0	6	6	7	14	33
1500	7	32	4	19	0	62
1600	0	0	6	1	1	8
1700	0	0	15	0	0	15
1800	0	0	1	0	0	1
1900	0	0	0	0	0	0
2000	0	0	0	0	0	0
TOTAL	32	158	149	140	54	533

Table 6. Number of trips measured by hour and month for 1990.

HOUR	MONTH					TOTAL
	MAY	JUNE	JULY	AUGUST	SEPTEMBER	
500	1	7	7	7	1	23
600	9	37	30	44	5	125
700	5	16	12	8	10	51
800	0	0	0	1	1	2
900	1	1	0	1	1	4
100	0	0	0	0	0	0
1100	0	0	0	0	0	0
1200	0	0	0	0	0	0
1300	0	0	0	0	2	2
1400	0	1	4	2	2	9
1500	1	11	27	15	2	56
1600	0	0	0	0	0	0
1700	0	0	0	0	0	0
1800	0	0	0	0	0	0
1900	0	0	0	0	0	0
2000	0	0	0	0	0	0
TOTALS	17	73	80	78	24	272

Table 7. Number of observation trips measured by hour and month, 1991.

HOUR	MONTH					TOTAL
	MAY	JUNE	JULY	AUGUST	SEPTEMBER	
500	0	12	9	19	0	40
600	6	31	35	29	4	105
700	4	5	20	9	8	46
800	4	0	0	0	2	6
900	1	1	0	0	0	2
1000	0	1	2	0	0	3
1100	0	0	0	0	0	0
1200	0	4	19	11	0	34
1300	0	2	6	5	1	14
1400	1	0	2	2	3	8
1500	0	1	4	8	0	13
1600	0	0	0	0	0	0
1700	0	0	0	0	0	0
1800	0	0	0	0	0	0
1900	0	0	0	0	0	0
2000	0	0	0	0	0	0
TOTAL	16	57	97	83	18	271

Four locations served as main points for turnaround during 1988, 1989, and 1991 (Table 8). These included Toklat (milepost 54), Stoney Hill (milepost 62), Wonder Lake (milepost 87), and Eielson (milepost 66). Teklanika Rest Stop (milepost 30), and Polychorme Pass (milepost 46), served as minor points for turnaround.

Table 8 . Number of buses that traveled, by month and year, to specific location before turning around for the return trip.

MONTH	YEAR	TOTAL	TOKLAT	STONY HILL	WONDER LAKE	EIELSON	PLOYCHORME	TEK
JULY	88	232	83	59	43	46	1	0
AUGUST	88	230	94	47	55	31	3	0
SEPTEMBER	88	78	21	15	26	12	4	0
	TOTAL	540	198	121	124	89	8	0
MAY	89	32	31	0	1	0	0	0
JUNE	89	158	88	23	25	22	0	0
JULY	89	149	45	43	40	21	0	0
AUGUST	89	140	69	24	32	15	0	0
SEPTEMBER	89	54	29	12	11	2	0	0
	TOTAL	533	262	102	109	60	0	0
MAY	91	16	14	0	0	0	0	2
JUNE	91	57	20	31	0	5	0	1
JULY	91	97	32	26	0	39	0	0
AUGUST	91	83	29	29	0	25	0	0
SEPTEMBER	91	18	13	4	0	1	0	0
	TOTAL	271	108	90	0	70	0	3

Table 9. Number of records of each species by year.

Species	1988 Records	1989 Records	1990 Records	1991 Records	Total
Caribou	2085	1928	730	1060	5803
Dall's Sheep	1488	1303	739	734	4264
Grizzly Bear	936	881	311	353	2481
Moose	466	537	243	290	1536
Wolf	63	64	41	23	191
Fox	32	55	56	70	213
Beaver	11	0	1	1	13
Wolverine	0	0	0	0	0
Golden Eagle	8	2	1	0	11
Marmot	1	1	1	0	3
Snowshoe Hare	0	0	0	0	0
Porcupine	6	3	3	0	12
Canada Goose	1	1	0	0	2
Falcon	0	2	0	0	2
Other	3	3	4	1	11
TOTAL RECORDS -Year	5100	4880	2129	2532	14641

There are 14,641 total records in the data base. These were collected for 14+ species over the 4 years (Table 9). Over 99% of the records are for caribou, Dall's sheep, grizzly bears, moose, and wolves. The fox (*Vulpes vulpes*), and other animals, were recorded sporadically, and, with the exception of the fox, in few numbers, therefore, further analysis of these data is not warranted. The data illustrate information requested on the data

forms, the singular interest in large mammals, and do not reflect the distribution of other animals along the road.

Caribou were the most common animals observed during all years except 1990 when records were almost equal to Dall's sheep (Table 9). This result is due to lack of shuttle drivers in 1990 (Table 3), who typically drove farther along the road than tour drivers and, consequently, reported more caribou. Dall's sheep were second most common, followed by grizzly bears, then moose, with foxes fifth, and wolves sixth in rank. Total records varied from a high with caribou of 5,803 to a low of 191 for wolves.

Total number of animals observed was almost equal on the north and south sides of the road, with 49% being on the north side, and 46% being on the south side (Table 10). Five percent of all observations were of animals on the road. More caribou adults and more caribou calves were observed on the south than on the north side of the road ($p=0.0006$ and $p=0.04$, Wilcoxon Rank Sum W test). There was no difference in side of road for Dall's sheep adults ($p=0.09$), lambs ($p=0.72$), grizzly bear adults ($p=0.26$), moose adults ($p=0.56$) and moose calves ($p=0.54$). More grizzly bear cubs were on the south than the north side of the road ($p=0.03$).

Table 10. Number of observations and percent of animals by side of, or on the road, 1988.

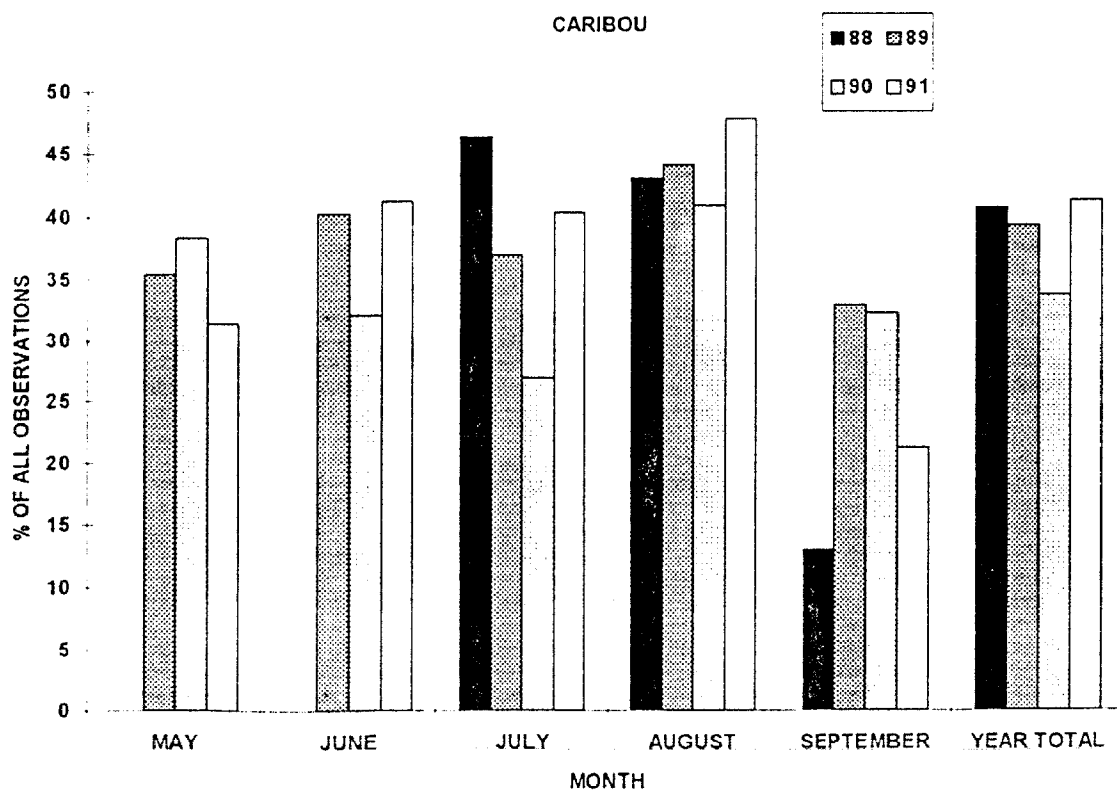
	MONTH							
	<u>July</u>		<u>August</u>		<u>September</u>		<u>Total for Season</u>	
	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>
North	876	40	1225	53	386	63	2487	49
South	1166	53	975	42	203	33	2344	46
On Road	140	6	101	4	26	4	267	5
Total	2182	43	2301	45	615	12	5098	100

CARIBOU

Caribou migrate to various habitats for wintering, calving (late May to early June), summer grazing, and rutting (September and October), therefore, caribou movements relative to the road have an impact on visitor observations (NPS 1989). Migration is described as follows: "Caribou use the prime calving and post-calving area west of the town of Cantwell from about May 1 through July 20. After calving, the herd moves to the north side of the Alaska Range, passing through the Polychrome Flats area as early as July. Herd movements follow the traditional migration route west and north to summer and winter ranges. When the herd calves north of the Alaska Range, most cows travel to the Cantwell area by approximately the first week in June and migrate back to the north from early to mid July" (NPS 1989).

Drivers made more stops for caribou than for other animals (Fig. 13 and Tables 12-29). Depending upon the month, caribou made up from 14% to over 45% of all stops for observation. Greatest variability was during September. Annually, stops to view caribou made up between 35% and 40% of all stops (Fig. 13).

FIG. 13. Percentage of stops for caribou, Dall's sheep, grizzly bears, moose, and wolves that were for caribou during four years.



Caribou were observed nearly every day of each season (Table 11). Annually, 83% to 96% of passengers observed caribou. Caribou were observed more consistently on shuttle trips than on tour trips because shuttle trips traveled farther along the road into areas where caribou were present. Depending upon the month, 72% to 100% of shuttle passengers observed caribou, compared to 58% to 100% of tour passengers.

Caribou were observed by 93% to 100% of the passengers during May, but there were fewer days of observation during that month. Typically, fewer passengers observed caribou during September than during other months (Table 11).

Table 11. Percentage of passengers who observed caribou by month and year and transportation type.

SPECIES	YEAR	MONTH	PASSENGER OBSERVERS	TOTAL PASSENGERS	PERCENT WHO OBSERVED	
CARIBOU	1988	SHUTTLE	JULY	2748	2781	98.81
			AUGUST	2345	2469	94.98
			SEPTEMBER	752	1045	71.96
			TOTAL	5845	6295	92.85
		TOUR	JULY	4821	5494	87.75
			AUGUST	4989	5250	95.03
			SEPTEMBER	867	1496	57.95
			TOTAL	10677	12240	87.23
		TOTAL	JULY	7569	8275	91.47
			AUGUST	7334	7719	95.01
			SEPTEMBER	1619	2541	63.72
			TOTAL	16522	18235	90.61
					
	1989	SHUTTLE	MAY	439	439	100.00
			JUNE	2206	2224	99.19
			JULY	1807	1807	100.00
			AUGUST	1846	1886	97.88
			SEPTEMBER	433	433	100.00
			TOTAL	6731	6789	99.10
		TOUR	MAY	414	414	100.00
			JUNE	2488	2705	91.98
			JULY	3385	3568	94.87
			AUGUST	3259	3393	96.05
			SEPTEMBER	1416	1548	91.47
TOTAL			10962	11628	94.00	

Table 11. Concluded.

TOTAL	MAY	853	853	100.00
	JUNE	4694	4929	95.23
	JULY	5192	5375	96.62
	AUGUST	5105	5279	96.70
	SEPTEMBER	1849	1981	93.34
	TOTAL	17693	18417	96.06
.....				
1990	MAY	715	715	100.00
TOTAL	JUNE	2747	3231	85.02
	JULY	2825	3691	76.54
	AUGUST	2927	3508	83.44
	SEPTEMBER	968	1108	87.36
	TOTAL	10192	12253	83.10
.....				
1991	MAY	640	688	93.02
TOTAL	JUNE	2397	2576	93.05
	JULY	3405	4025	84.60
	AUGUST	3095	3534	87.58
	SEPTEMBER	524	849	61.72
	TOTAL	10061	11672	86.20

Individual sightings were plotted against milepost to illustrate the location where caribou could possibly occur (Figs. 14-17). During the study caribou were observed along almost the entire length of the 87 mile road (Figs. 14-17). Patterns of location and general numbers per observation, with the exception of large groups, were similar year to year. Two exceptions occurred in the yearly data sets: 1) groups larger than 40 animals were not observed in 1990 and 1991, and 2) animals were not observed past mile 74 in 1990 and 1991, whereas, in 1988-1989, they were observed through mile 87. These differences are due to varying natural caribou distribution, fewer observation drivers and fewer buses traveling the entire length of the road during the latter two years.

Fig. 14. Location and number of caribou per observation at each milepost for 1988.

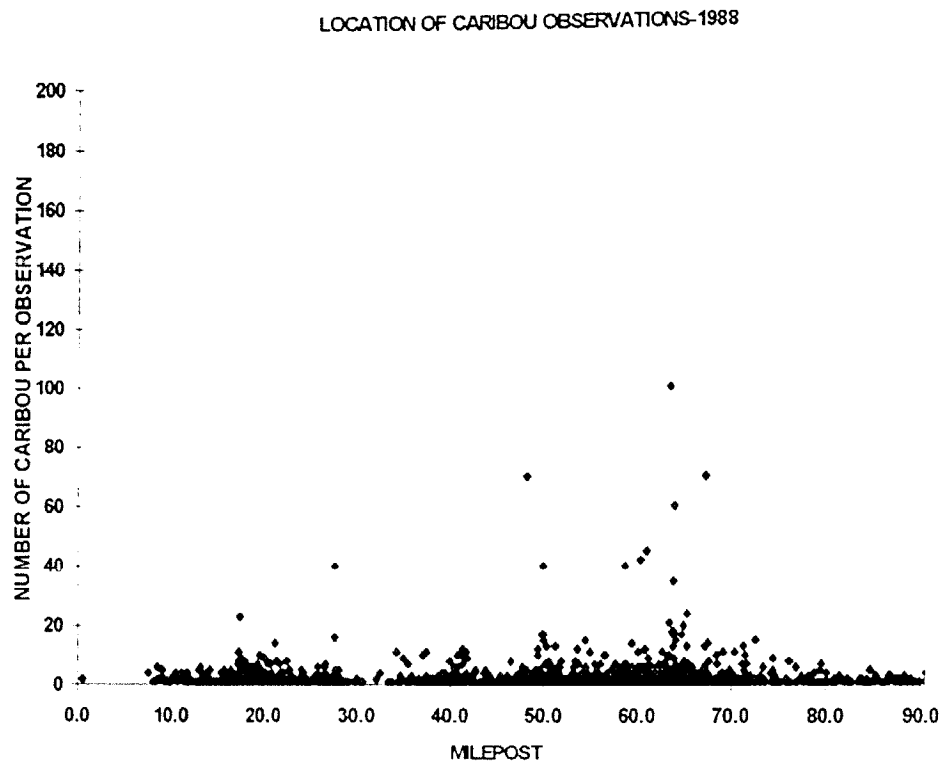


Fig. 15. Location and number of caribou per observation at each milepost for 1989.

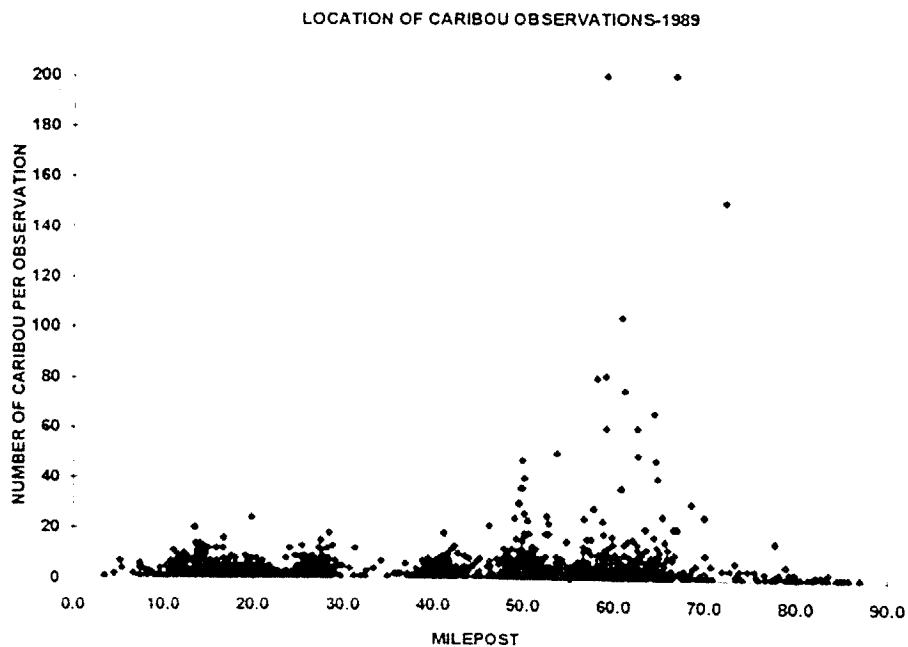


Fig. 16. Location and number of caribou per observation at each milepost for 1990.

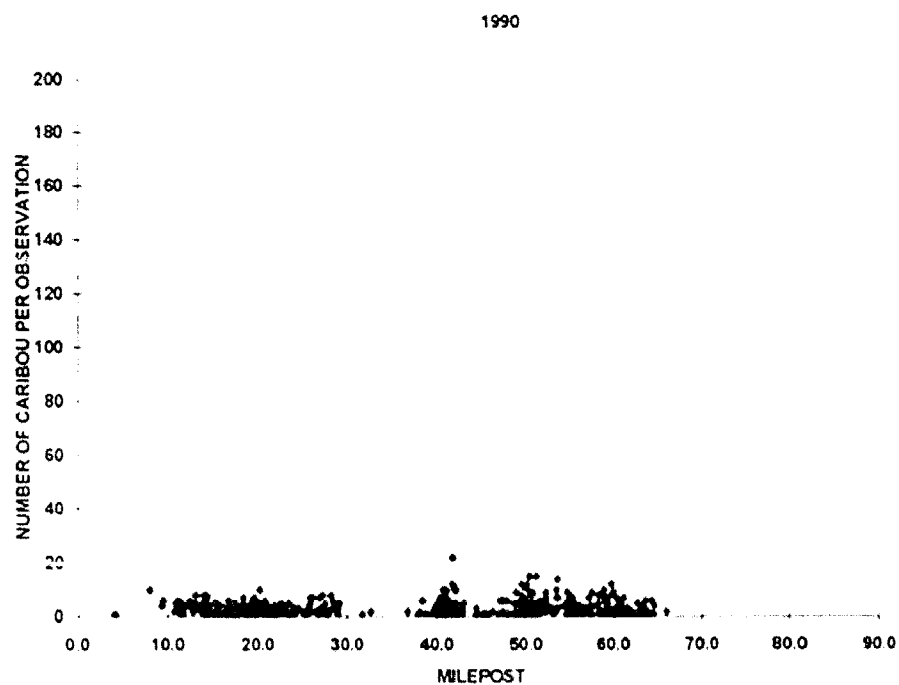
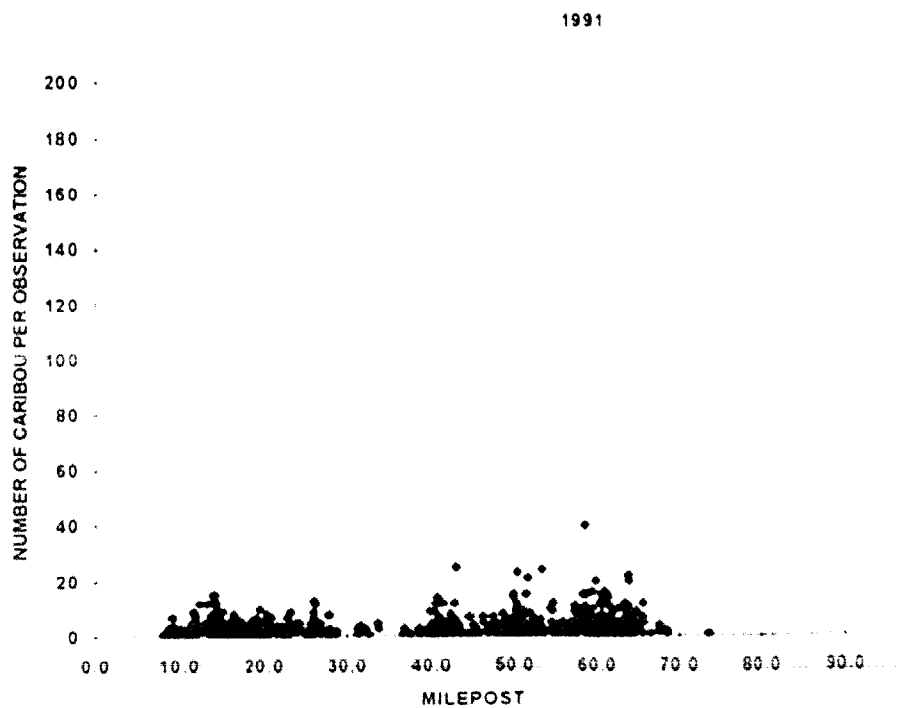


Fig. 17. Location and number of caribou per observation at each milepost for 1991.



The mean number of caribou observed per bus trip per milepost was calculated for each month and for the year of 1989 (Figs. 18-23). These data show the relative caribou usage of habitat along the road by month and for the entire year.

Fewer than 0.2 caribou per mile were observed during each month, and for the year from milepost 1-30. Minor numbers of caribou were observed from milepost 45-55 during May. From there to mile 87, caribou were not recorded during May either due to lack of traffic (one bus) (Table 8), or absence of caribou. The section of the road with the highest consistent number of caribou was from approximately milepost 50-73 (Figs. 19-23). The greatest number of caribou observed per milepost was in June (Fig. 19).

Mileposts 65-67, the area around Eielson Visitor Center, showed the highest number of caribou per mile (Fig. 23).

FIG. 18. MEAN NUMBER OF CARIBOU PER MILEPOST BUS TRIP, MAY, 1989

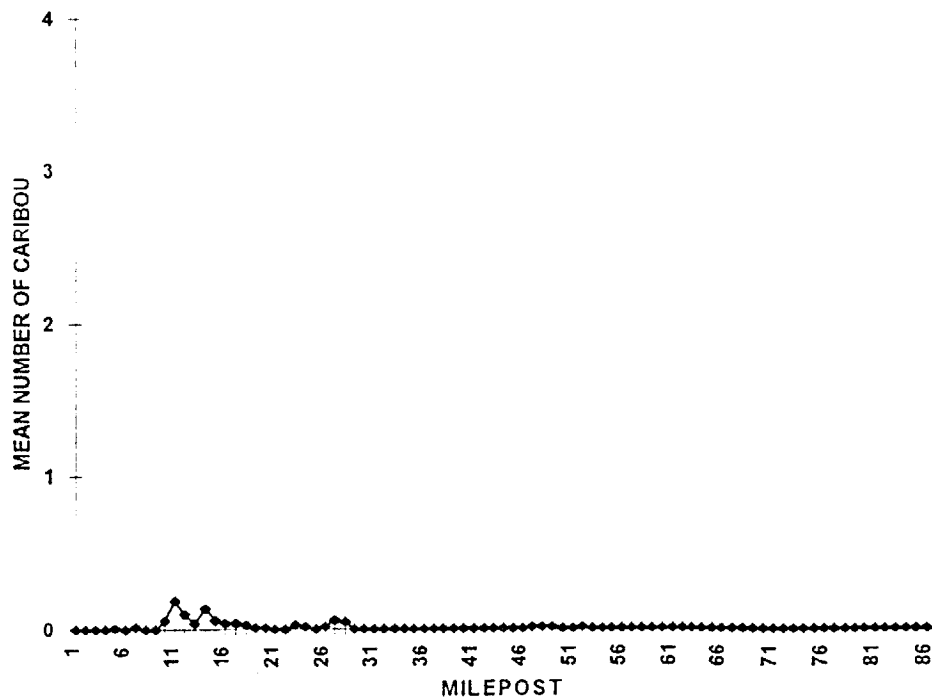


FIG. 19. MEAN NUMBER OF CARIBOU PER MILEPOST PER BUS TRIP, JUNE, 1989

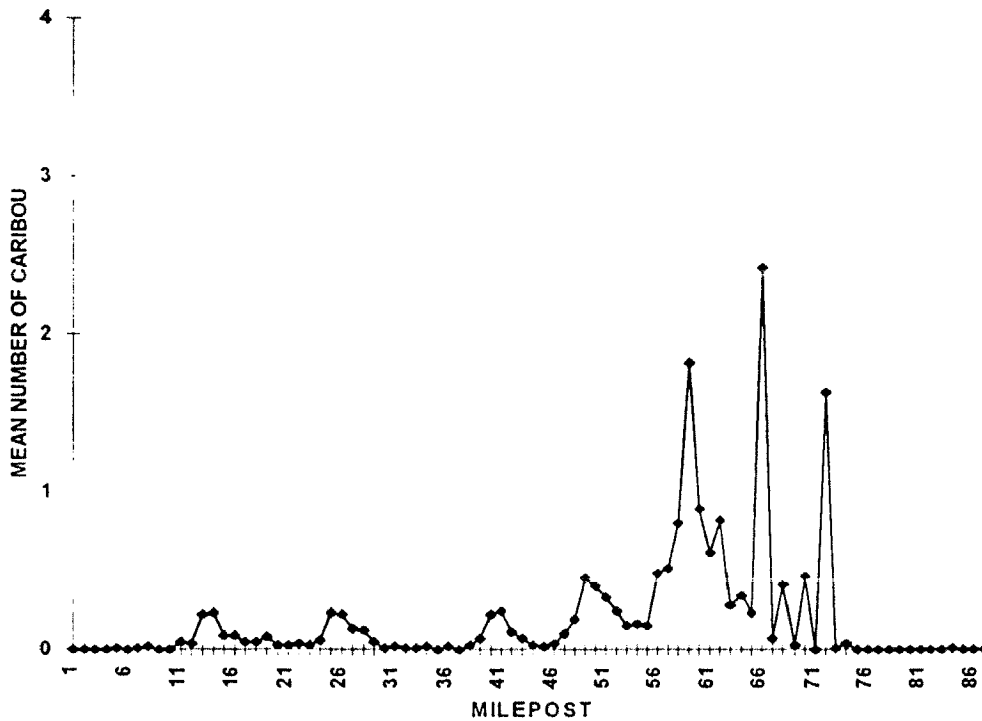


FIG. 20. MEAN NUMBER OF CARIBOU PER MILEPOST PER BUS TRIP, JULY, 1989

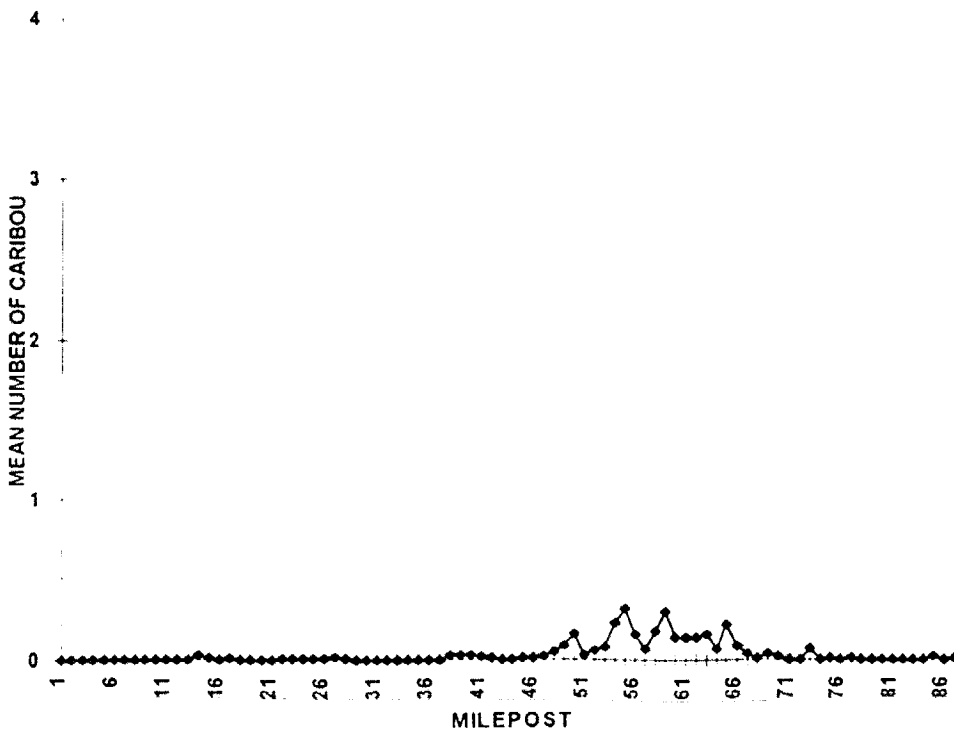


FIG. 21. MEAN NUMBER OF CARIBOU PER MILEPOST PER BUS TRIP, AUGUST, 1989

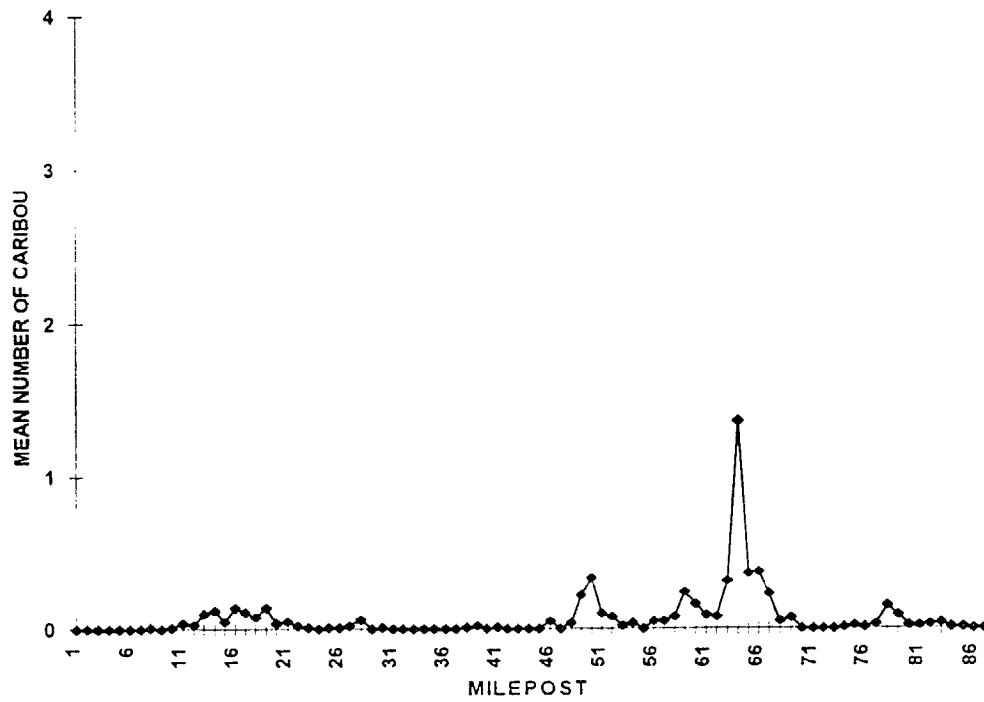


FIG. 22. MEAN NUMBER OF CARIBOU PER MILEPOST PER BUS TRIP, SEPTEMBER, 1989

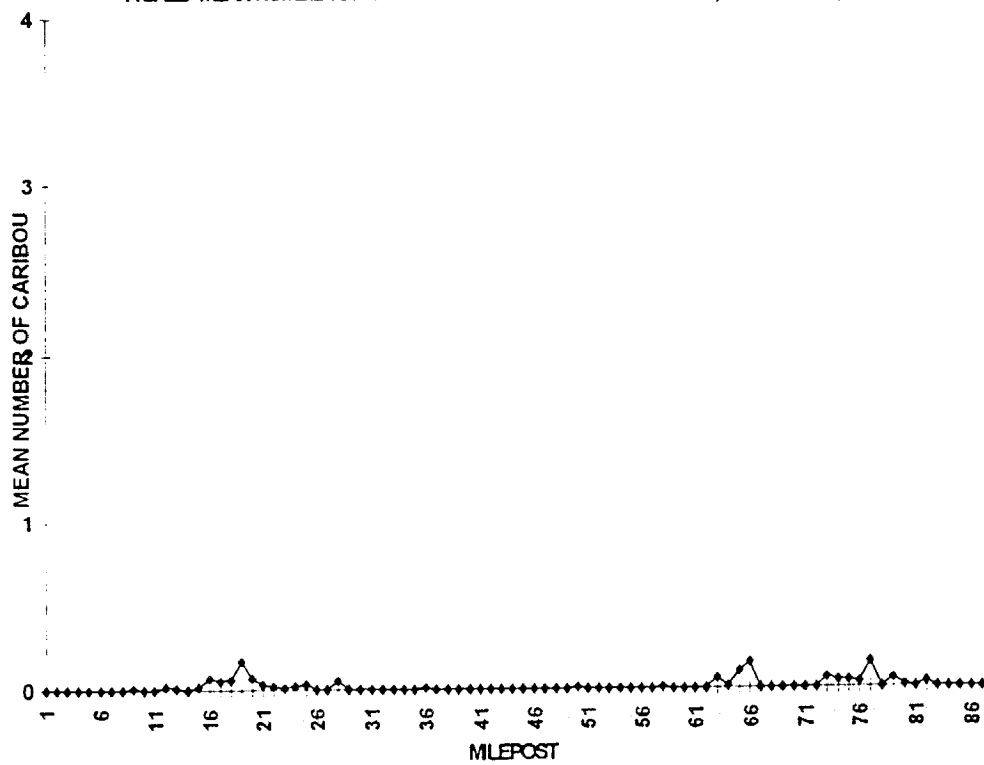
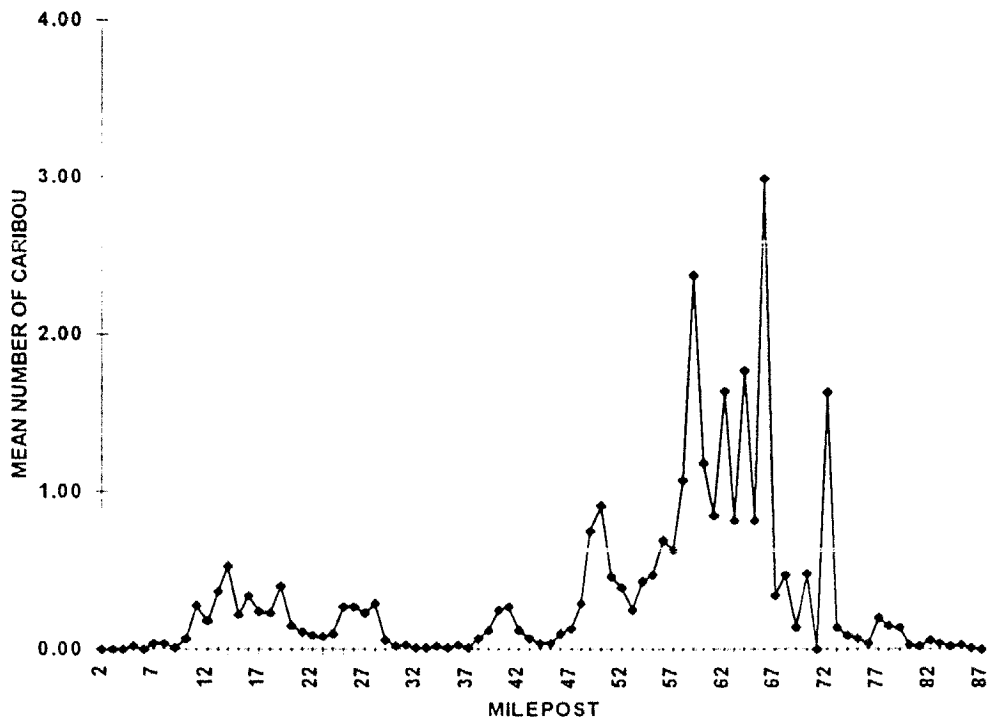


FIG. 23. MEAN NUMBER OF CARIBOU PER MILEPOST PER BUS TRIP, 1989



The number of caribou in each observation was plotted against date of observation to determine if the number or frequency of observations changed during the season (Figs. 24-27). With the exception of the few large groups observed in 1988 and 1989, the numbers and frequency of observation of caribou changed little through the season and between years.

FIG. 24. NUMBER OF CARIBOU OBSERVED BY JULIAN DATE, 1988

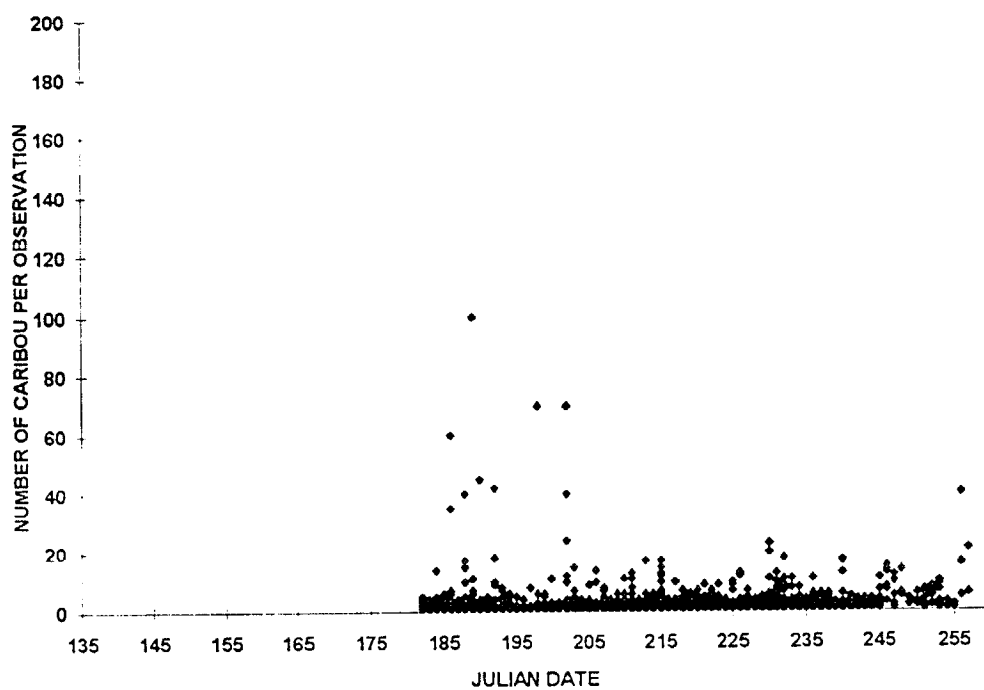
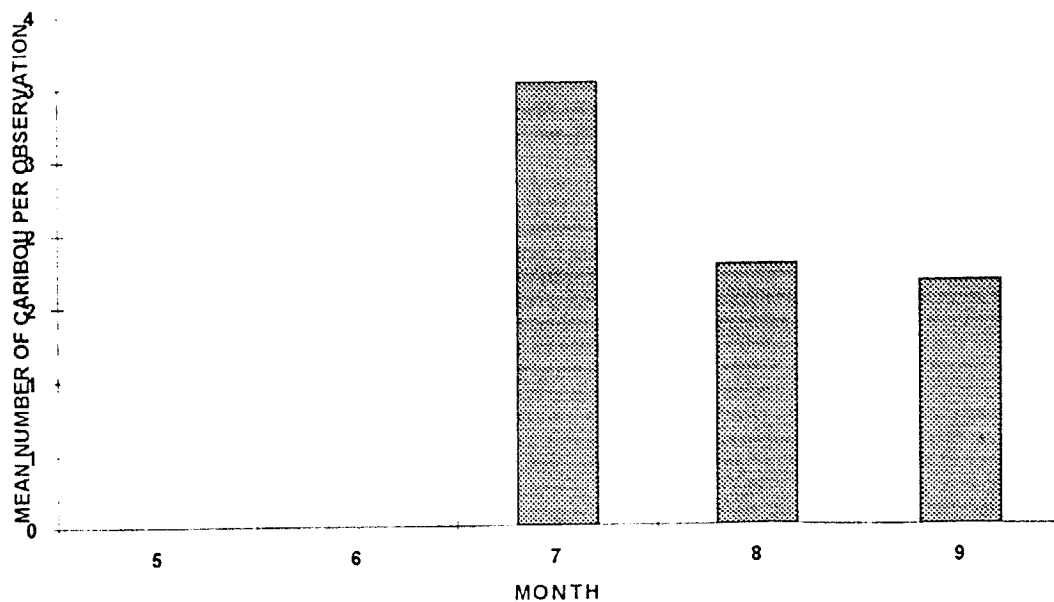


FIG. 24 A. MEAN NUMBER OF CARIBOU PER OBSERVATION BY MONTH, 1988



Note: Blank spaces for months 5 and 6 mean no data.

FIG. 25. NUMBER OF CARIBOU PER OBSERVATION BY JULIAN DATE, 1989

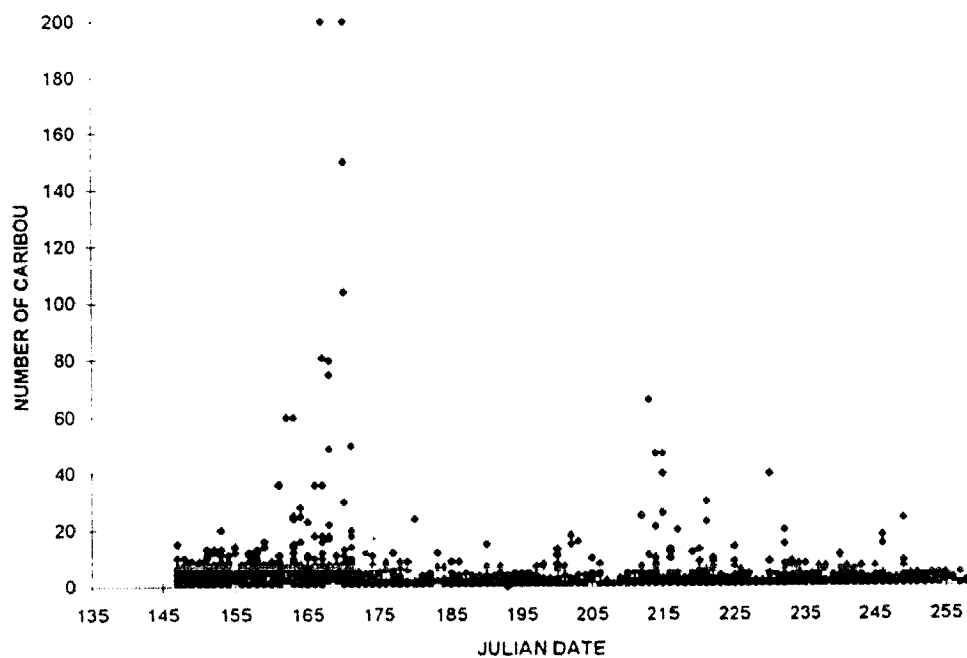


FIG. 25A. MEAN NUMBER OF CARIBOU PER OBSERVATION BY MONTH, 1989

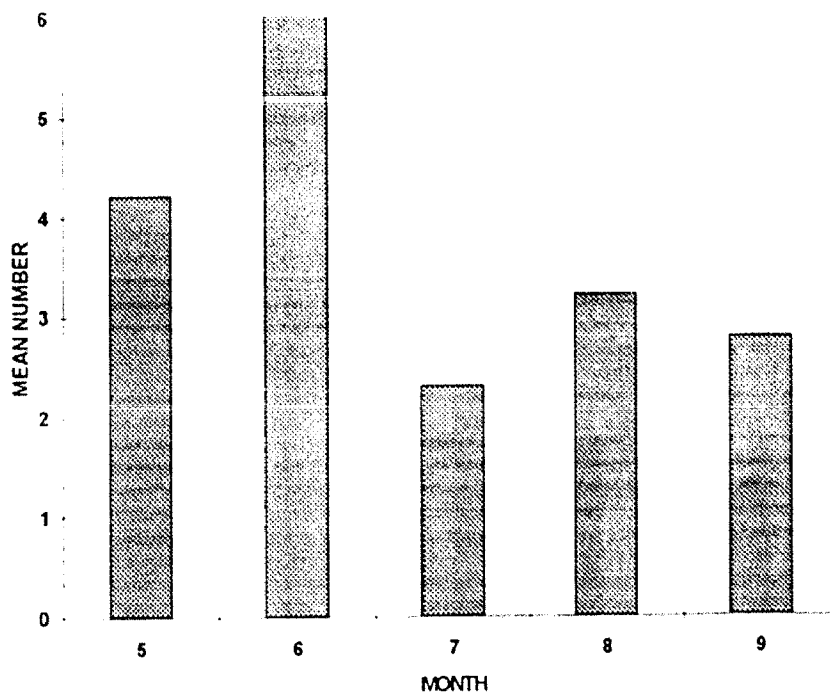


FIG. 26. NUMBER OF CARIBOU PER OBSERVATION BY JULIAN DATE, 1990

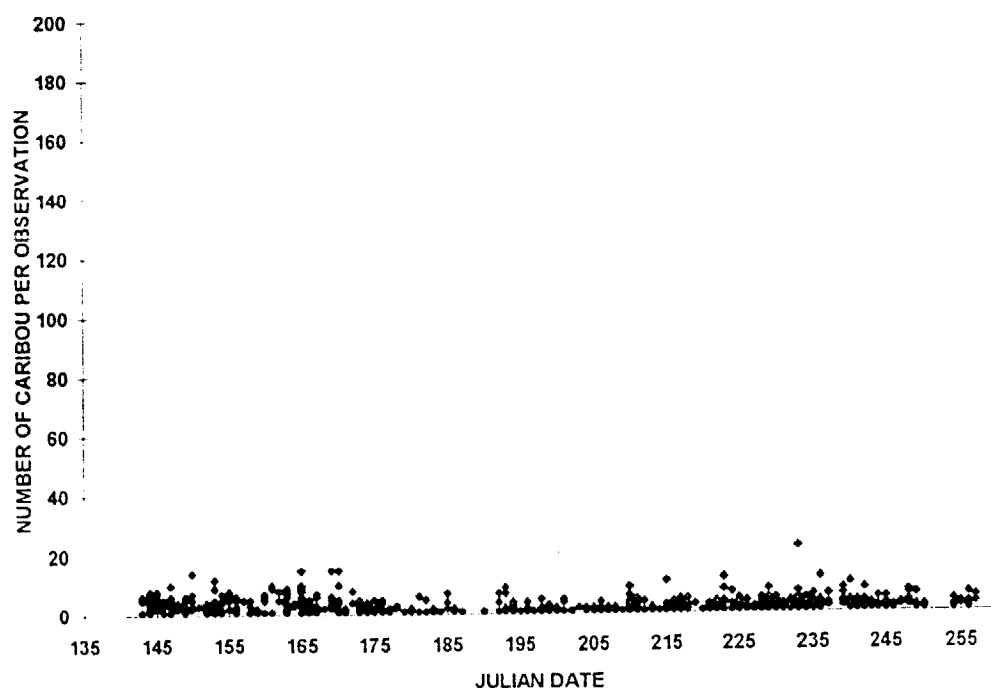


FIG. 26A. MEAN NUMBER OF CARIBOU PER OBSERVATION BY MONTH, 1990

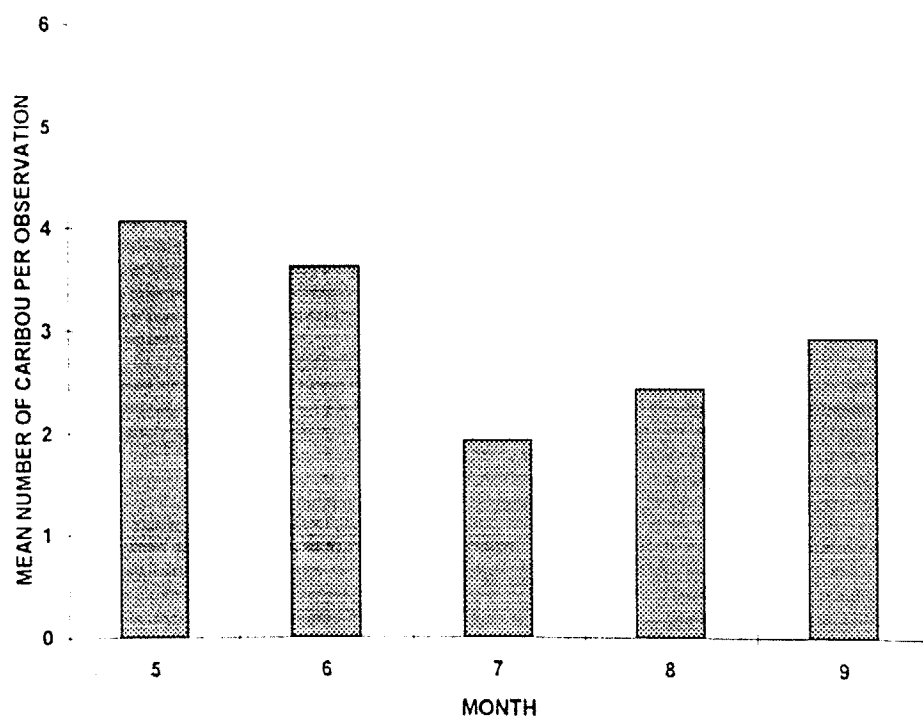


FIG. 27. NUMBER OF CARIBOU PER OBSERVATION BY JULIAN DATE, 1991.

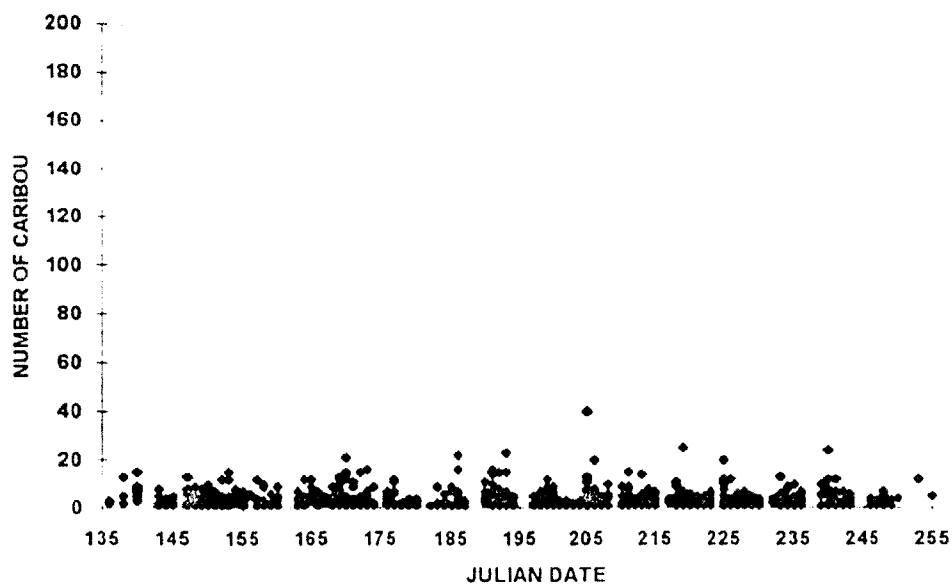
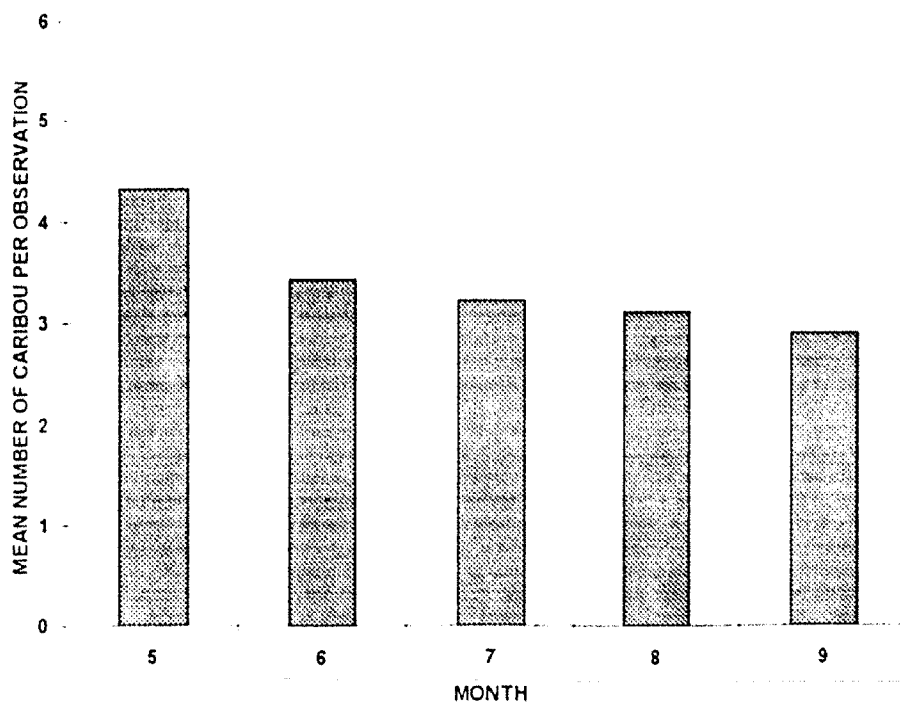


FIG. 27A. MEAN NUMBER OF CARIBOU PER OBSERVATION BY MONTH, 1991



The number of caribou per observation changed little during the hours measured (Figs. 28-31). Too few observations of groups ≥ 40 animals were made to determine presence by hour of the day.

Fig. 28. Number of caribou per observation by hour of the day, 1988.

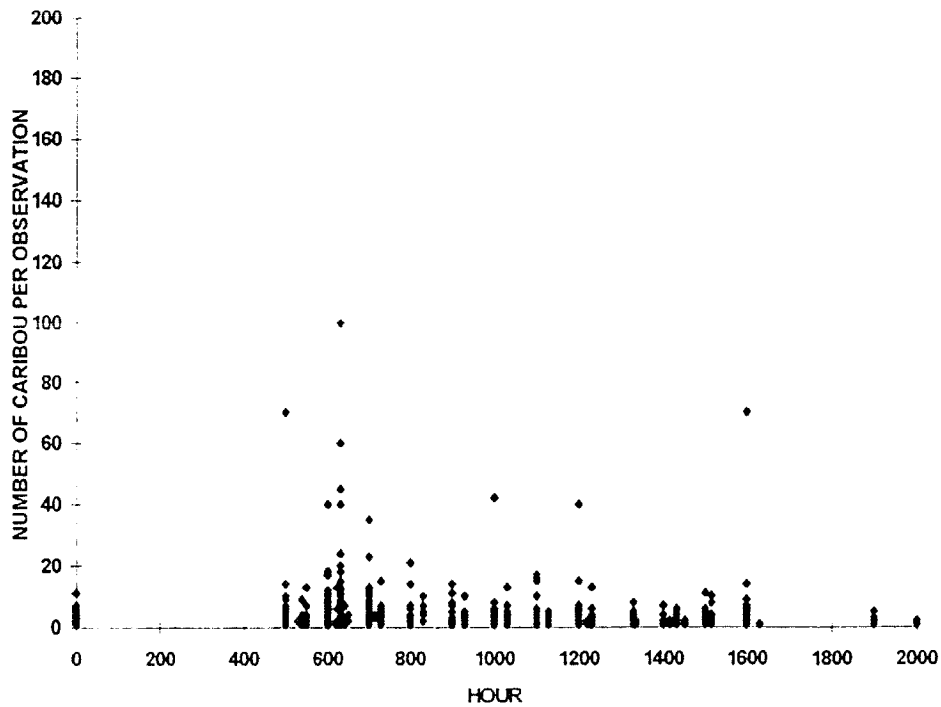
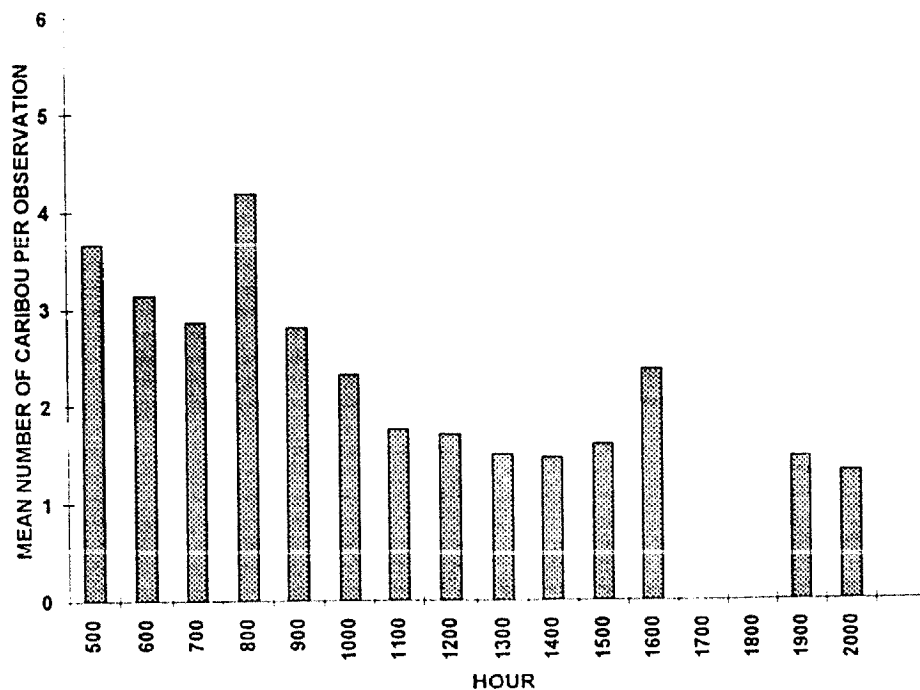


FIG. 28A. MEAN NUMBER OF CARIBOU PER OBSERVATION BY HOUR OF BUS START, 1988



Note: No bus departures occurred at hours 1700 and 1800.

FIG. 29. NUMBER OF CARIBOU PER OBSERVATION BY HOUR OF THE DAY, 1989.

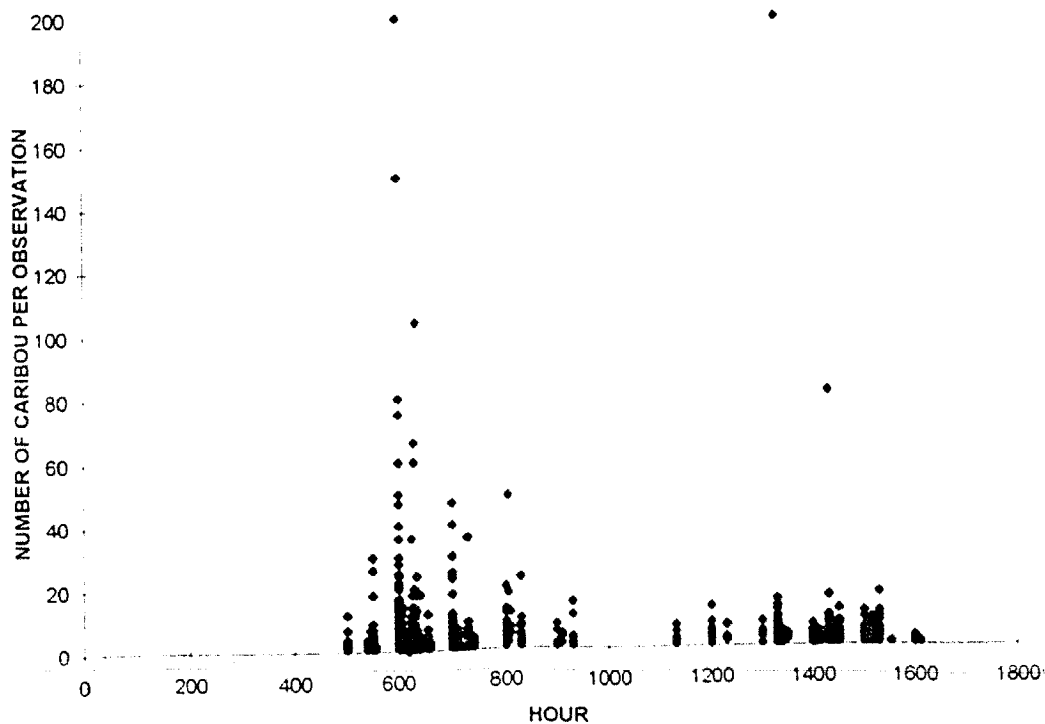
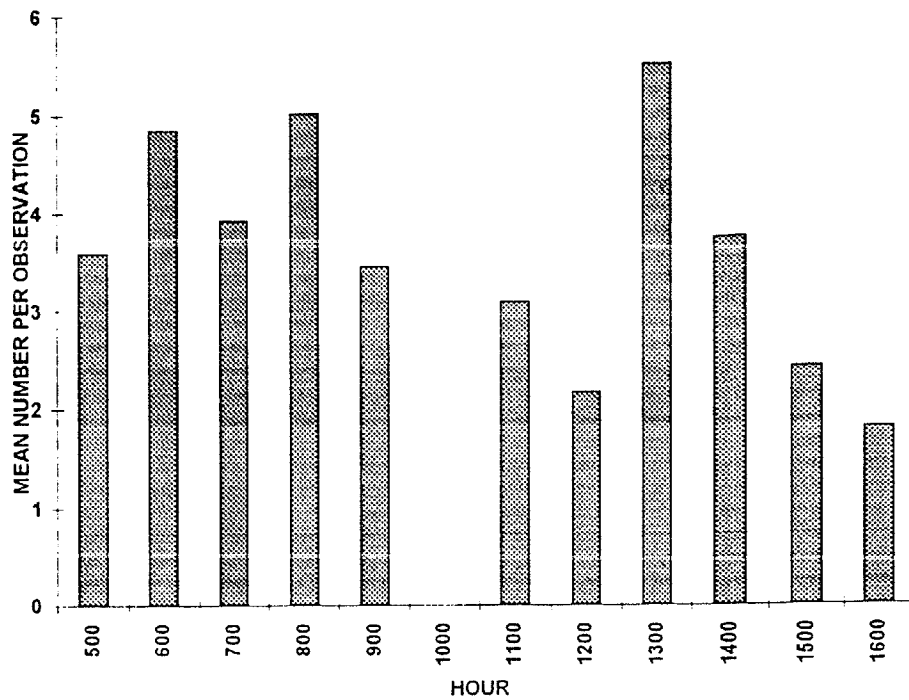


FIG. 29A. MEAN NUMBER OF CARIBOU PER OBSERVATION BY HOUR OF BUS DEPARTURE



Note: No bus departures occurred at 1000 hrs.

FIG. 30. NUMBER OF CARIBOU PER OBSERVATION BY HOUR OF THE DAY, 1990.

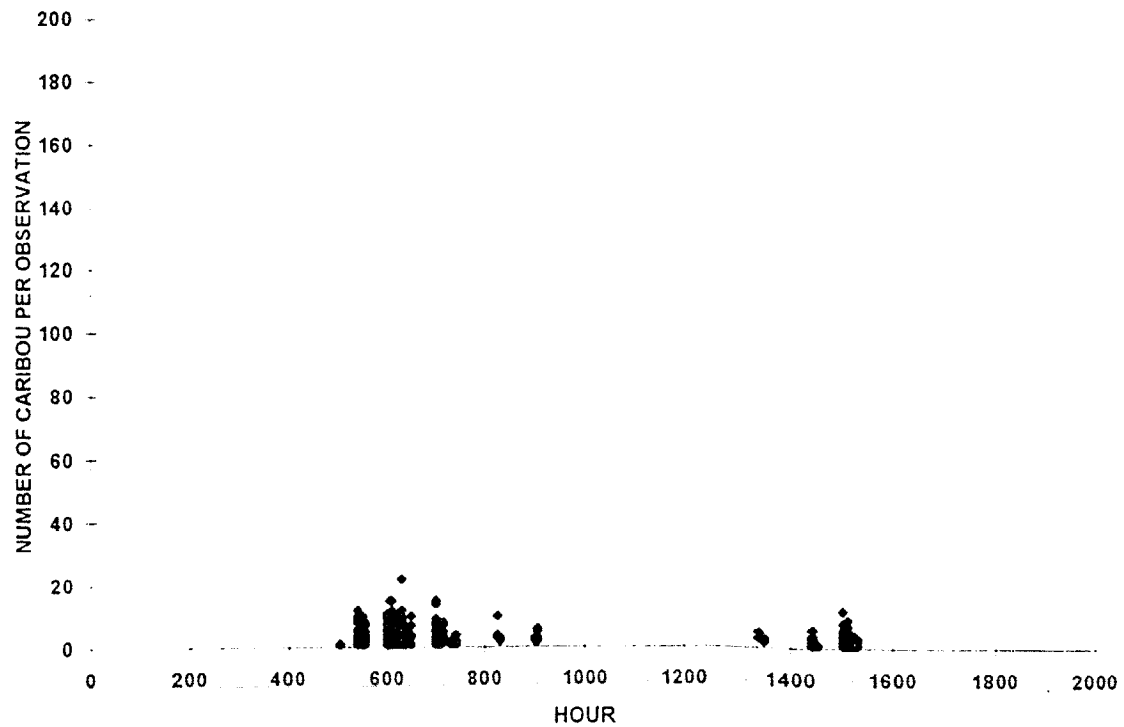


FIG. 30 A. MEAN NUMBER OF CARIBOU PER OBSERVATION BY HOUR OF BUS DEPARTURE, 1990

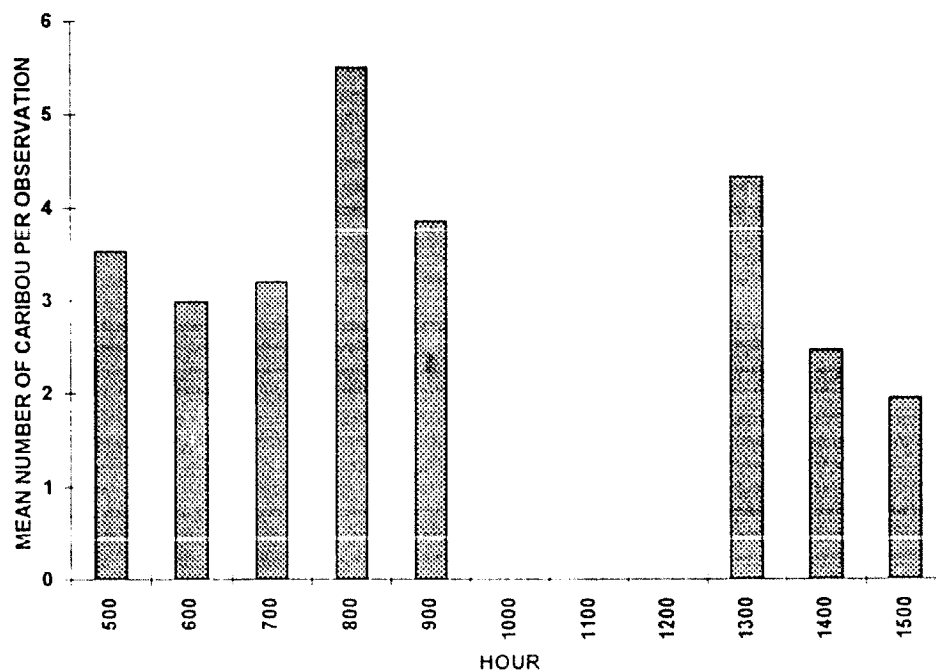


FIG. 31. NUMBER OF CARIBOU PER OBSERVATION BY HOUR OF THE DAY, 1991.

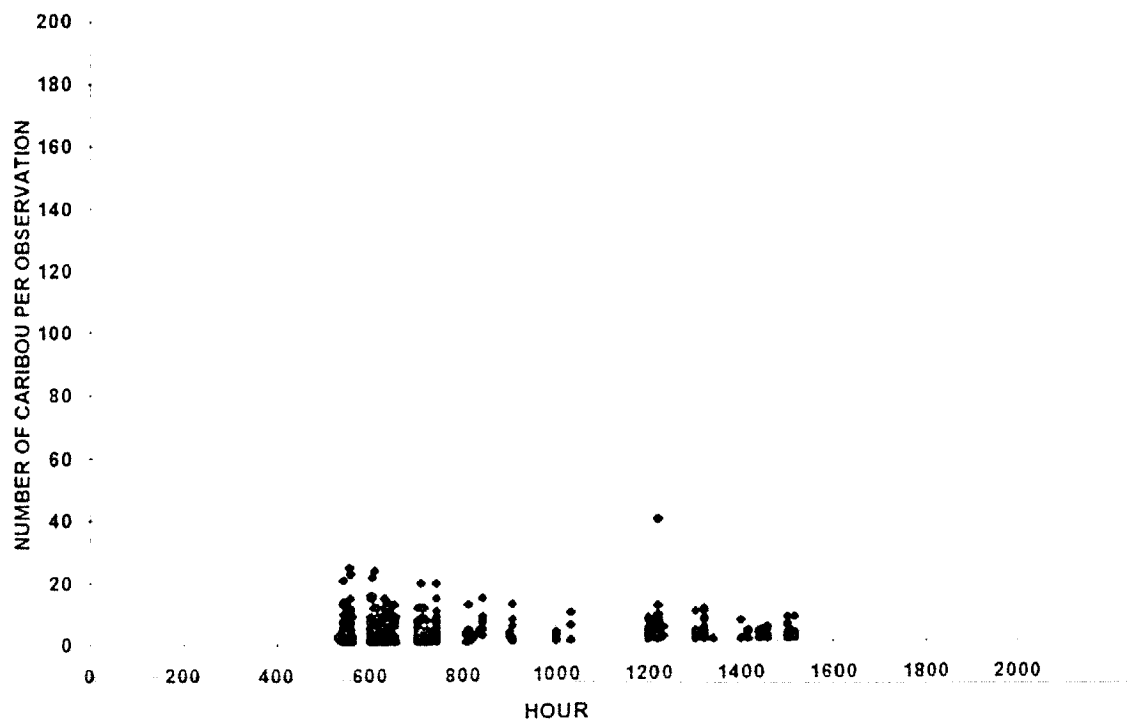
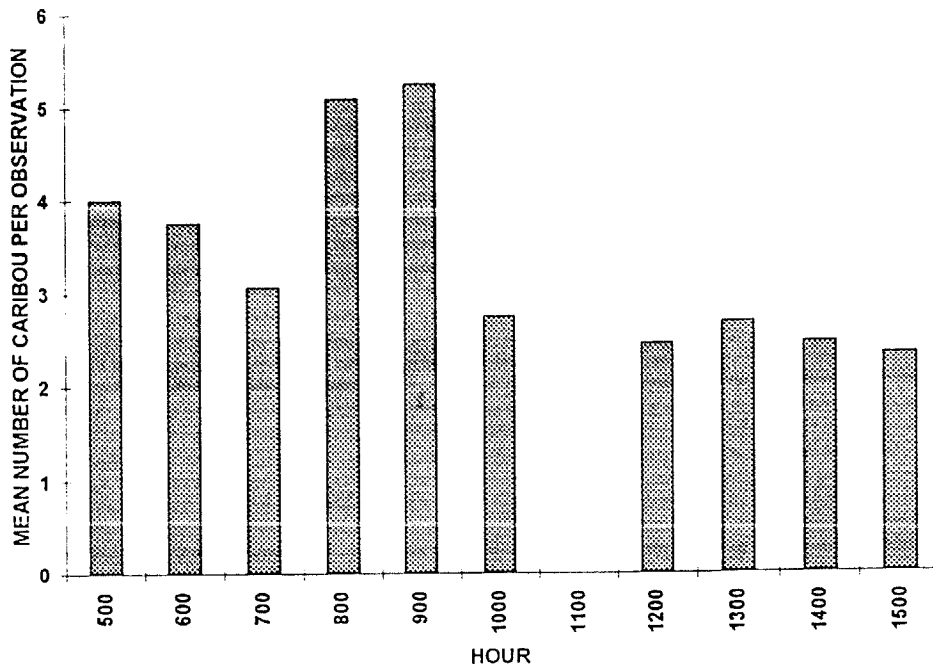


FIG. 31A. MEAN NUMBER OF CARIBOU PER OBSERVATION BY HOUR OF BUS DEPARTURE,
1991



Caribou group size fluctuated May through September (Tables 12-29), from groups to single individuals, and back to small groups. Caribou were more frequently present in groups of <10 animals during May and June. During July and August, individuals were most commonly observed, with groups of five or more animals making up only 10% of all other observations. Groups of 2 or 3 caribou were typically as common as single individuals when the visitor season closed in September and sample sizes were smaller than previous months. Groups ≥ 5 animals made up 12% (1989) to 39% (1988) of observations for September.

Mean caribou group size for the season of years measured is shown in Figs. 32-35. Single animals were present in 35-60% of the stops to observe caribou. From that point, the percentage of larger groups falls off rapidly. Stops where groups of 2 animals were observed were made 15%-20% of the time. Three to five animals occurred at stops 5%-<15% of the time. No group larger than 5 animals was observed at >5% of the stops.

Stops were made to observe groups of animals >40 caribou in size 6 times in 1988, 10 times in 1989, 0 in 1990, and 1 time in 1991.

Three groups of >100 caribou were reported in 1989 (and could possibly have been the same group reported by different drivers) (Fig. 33). Absence of large groups in 1990 and 1991 was apparently due to fewer bus trips to and beyond milepost 66 (see page 38) where large groups of caribou are generally located.

Table 12. Group size, number and percentage of stops for observation of caribou, July, 1988.

GROUP	NUMBER OF	%	% OBSERVATIONS
SIZE	STOPS	STOPS	BY GROUP SIZE
0	1171	53.6%	other animals
1	672	30.8%	66.4%
2	169	7.7%	16.7%
3	58	2.7%	5.7%
4	44	2.0%	4.3%
5	19	0.9%	1.9%
6	13	0.6%	1.3%
7	5	0.2%	0.5%
8	4	0.2%	0.4%
9	2	0.1%	0.2%
10	4	0.2%	0.4%
11	4	0.2%	0.4%
12	1	0.0%	0.1%
13	1	0.0%	0.1%
14	2	0.1%	0.2%
15	2	0.1%	0.2%
17	1	0.0%	0.1%
18	1	0.0%	0.1%
24	1	0.0%	0.1%
35	1	0.0%	0.1%
40	2	0.1%	0.2%
42	1	0.0%	0.1%
45	1	0.0%	0.1%
60	1	0.0%	0.1%
70	2	0.1%	0.2%
100	1	0.0%	0.1%
TOTAL	2183	100.0%	100.0%

2183-1171=1012 stops to observe caribou during July, 1988.

Table 13. Group size, number and percentage of stops for observation of caribou, August, 1988.

GROUP	NUMBER OF	%	% OBSERVATIONS
SIZE	STOPS	STOPS	BY GROUP SIZE
0	1309	56.9%	other animals
1	554	24.1%	55.8%
2	183	7.9%	18.4%
3	98	4.3%	9.9%
4	59	2.6%	5.9%
5	35	1.5%	3.5%
6	21	0.9%	2.1%
7	13	0.6%	1.3%
8	3	0.1%	0.3%
9	5	0.2%	0.5%
10	5	0.2%	0.5%
11	4	0.2%	0.4%
12	2	0.1%	0.2%
13	4	0.2%	0.4%
15	1	0.0%	0.1%
17	3	0.1%	0.3%
18	1	0.0%	0.1%
20	1	0.0%	0.1%
23	1	0.0%	0.1%
TOTAL	2302	100.0%	100.0%

Table 14. Group size, number and percentage of stops for observation of caribou, September, 1988

GROUP	NUMBER OF	%	% OBSERVATIONS
SIZE	STOPS	STOPS	BY GROUP SIZE
0	535	87.0%	other animals
1	18	2.9%	22.5%
2	17	2.8%	21.3%
3	5	0.8%	6.3%
4	5	0.8%	6.3%
5	4	0.7%	5.0%
6	6	1.0%	7.5%
7	8	1.3%	10.0%
8	5	0.8%	6.3%
9	1	0.2%	1.3%
10	2	0.3%	2.5%
11	1	0.2%	1.3%
12	1	0.2%	1.3%
13	1	0.2%	1.3%
14	2	0.3%	2.5%
15	1	0.2%	1.3%
16	1	0.2%	1.3%
21	1	0.2%	1.3%
40	1	0.2%	1.3%
TOTAL	615	100.0%	100.0%

FIG. 32. CARIBOU GROUP SIZE, JULY-SEPTEMBER, 1988

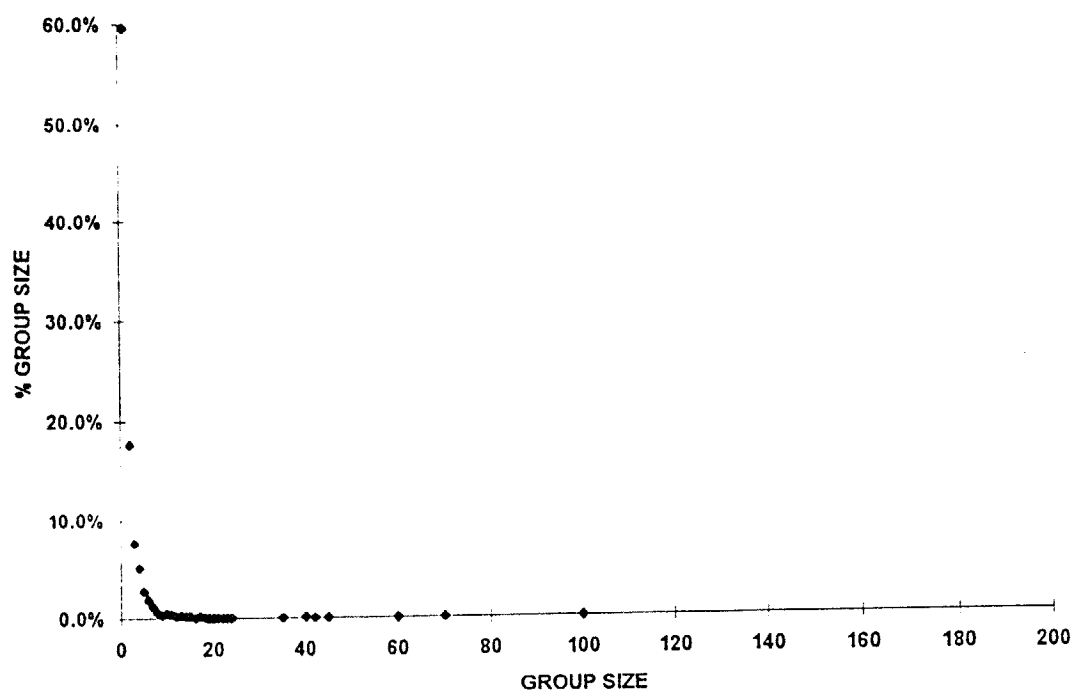


Table 15. Group size, number and percentage of stops for observation of caribou, May, 1989.

MAY 1989			
Group Size	Number of Stops	% Stops	% Observations by Group Size
0	218	64.5	other animals
1	21	6.2	15.9
3	14	4.1	11.7
4	21	6.2	17.5
5	14	4.1	11.7
6	9	2.7	7.5
7	7	2.1	5.8
8	5	1.5	4.2
9	2	0.6	1.7
10	5	1.5	4.2
11	1	0.3	0.8
12	0	0	0
13	1	0.3	0.8
14	0	0	0
15	1	0.3	0.8
16	0	0	0
17	0	0	0
18	0	0	0
19	0	0	0
20	0	0	0
.....			
Totals	338	100	99.3
338-218=120 stops were made to observe caribou during May, 1989			

Table 16. Group size, number and percentage of stops,
for observation of caribou, June, 1989.

Group Size	Number of Stops	JUNE % Stops	% Observations by Group Size
0	1092	59.7	other animals
1	145	7.9	19.7
2	120	6.6	16.3
3	103	5.6	14.0
4	71	3.9	9.7
5	58	3.2	7.9
6	47	2.6	6.4
7	53	2.9	7.2
8	39	2.1	5.3
9	18	1.0	2.5
10	9	0.5	1.2
11	9	0.5	1.2
12	16	0.9	2.2
13	4	0.2	0.5
14	5	0.3	0.7
15	2	0.1	0.3
16	5	0.3	0.7
17	3	0.2	0.4
18	5	0.3	0.7
20	2	0.1	0.3
22	1	0.1	0.3
23	1	0.1	0.1
24	2	0.1	0.3
25	2	0.1	0.3
28	1	0.1	0.1
30	1	0.1	0.1
36	3	0.2	0.4
49	1	0.1	0.1
50	1	0.1	0.1
60	2	0.1	0.3
75	1	0.1	0.1
80	1	0.1	0.1
81	1	0.1	0.1
104	1	0.1	0.1
150	1	0.1	0.1
200	2	0.1	0.3
.....			
Totals	1828	100	100.0
1828-1092=736 stops were made to observe caribou during June, 1989.			

Table 17. Group size, number and percentage of stops,
for observation of caribou, July, 1989.

JULY			
Group Size	Number of Stops	% Stops	% Observations by Group Size
0	699	62.9	other animals
1	240	21.6	58.1
2	68	6.1	16.5
3	30	2.7	7.3
4	28	2.5	6.8
5	23	2.1	5.6
6	1	0.1	0.2
7	9	0.8	2.2
8	3	0.3	0.7
9	1	0.1	0.2
10	2	0.2	0.5
11	1	0.1	0.2
12	1	0.1	0.2
13	1	0.1	0.2
15	2	0.1	0.5
16	1	0.1	0.2
18	1	0.1	0.2
25	1	0.1	0.2

Totals 1112 100 99.8
1112-699=413 stops to observe caribou during July, 1989.

Table 18. Group size, number and percentage of stops,
for observation of caribou, August, 1989.

AUGUST			
Group Size	Number of Stops	% Stops	% Observations by Group Size
0	646	55.8	other animals
1	234	20.2	45.8
2	104	9.0	20.4
3	63	5.4	12.3
4	41	3.5	8.0
5	14	1.2	2.7
6	13	1.1	2.5
7	7	0.6	1.4
8	4	0.3	0.8
9	7	0.6	1.4
10	3	0.3	0.6
11	2	0.2	0.4
12	2	0.2	0.4
13	4	0.3	0.8
14	1	0.1	0.2
15	1	0.1	0.2
20	3	0.3	0.6
26	1	0.1	0.2
30	1	0.1	0.2
40	2	0.2	0.4
66	1	0.1	0.2
Totals	1157	100	99.5
1157-646= 511 stops to observe caribou during August, 1989.			

Table 19. Group size, number and percentage of stops,
for observation of caribou, September, 1989.

Group Size	Number of Stops	SEPTEMBER	
		% Stops	% Observations by Group Size
0	298	67	other animals
1	49	11	33.3
2	39	8.8	26.5
3	24	5.4	16.3
4	16	3.6	10.9
5	10	2.2	6.8
6	1	0.2	0.7
7	4	0.9	2.7
8	0	0	0
9	1	0.2	0.7
10	0	0	0
11	0	0	0
12	0	0	0
13	0	0	0
14	0	0	0
15	1	0.2	0.7
16	0	0	0
17	0	0	0
18	1	0.2	0.7
19	0	0	0
20	0	0	0
21	0	0	0
22	0	0	0
23	0	0	0
24	1	0.2	0.7
.....			
Totals	445	99.9	100.0
445-298=147 stops were made to observe caribou during September, 1989.			

FIG. 33. CARIBOU GROUP SIZE, 1989 SEASON

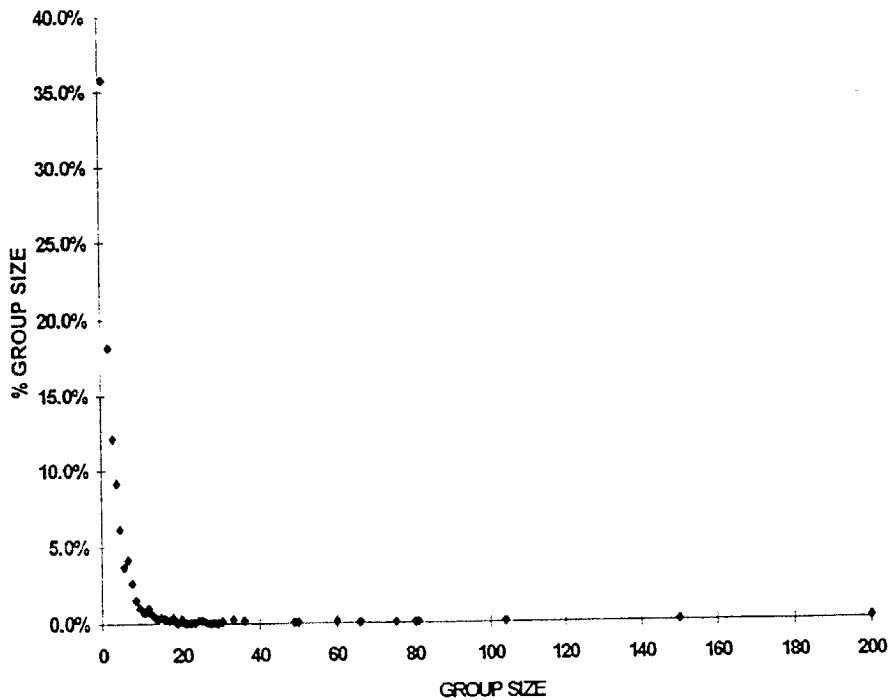


Table 20. Group size, number and percentage of stops for observation of caribou, May, 1990.

GROUP SIZE	NUMBER OF STOPS	% STOPS	% OBSERVATIONS BY GROUP SIZE
0	93	61.6%	other animals
1	7	4.6%	12%
2	14	9.3%	24%
3	13	8.6%	22%
4	7	4.6%	12%
5	7	4.6%	12%
6	3	2.0%	5%
7	1	0.7%	2%
9	2	1.3%	3%
10	1	0.7%	2%
12	2	1.3%	3%
14	1	0.7%	2%
TOTAL	151	100.0%	100%

Table 21. Group size, number and percentage of stops for observation of caribou, June, 1990.

GROUP SIZE	NUMBER OF STOPS	% STOPS	% OBSERVATIONS BY GROUP SIZE
0	413	67.8%	other animals
1	52	8.5%	27%
2	48	7.9%	24%
3	21	3.4%	11%
4	15	2.5%	8%
5	20	3.3%	10%
6	13	2.1%	7%
7	7	1.1%	4%
8	8	1.3%	4%
9	4	0.7%	2%
10	5	0.8%	3%
15	3	0.5%	2%
TOTAL	609	100.0%	100%

Table 22. Group size, number and percentage of stops for observation of caribou, July, 1990.

GROUP SIZE	NUMBER OF STOPS	% STOPS	% OBSERVATIONS BY GROUP SIZE
0	383	73.0%	other animals
1	84	16.0%	59%
2	30	5.7%	21%
3	10	1.9%	7%
4	8	1.5%	6%
5	4	0.8%	3%
6	1	0.2%	1%
7	3	0.6%	2%
9	2	0.4%	1%
TOTAL	525	100.0%	100%

Table 23. Group size, number and percentage of stops for observation of caribou, August, 1990.

GROUP SIZE	NUMBER OF STOPS	% STOPS	% OBSERVATIONS BY GROUP SIZE
0	348	59.0%	other animals
1	115	19.5%	47.5%
2	44	7.5%	18.2%
3	41	6.9%	16.9%
4	22	3.7%	9.1%
5	8	1.4%	3.3%
6	3	0.5%	1.2%
7	1	0.2%	0.4%
8	4	0.7%	1.7%
10	1	0.2%	0.4%
11	1	0.2%	0.4%
12	1	0.2%	0.4%
22	1	0.2%	0.4%
TOTAL	590	100.0%	100.0%

Table 24. Group size, number and percentage of stops for observation of caribou, September, 1990.

GROUP SIZE	NUMBER OF STOPS	% STOPS	% OBSERVATIONS BY GROUP SIZE
0	100	67.6%	other animals
1	16	10.8%	33.3%
2	11	7.4%	22.9%
3	10	6.8%	20.8%
4	3	2.0%	6.3%
5	3	2.0%	6.3%
6	4	2.7%	8.3%
7	1	0.7%	2.1%
TOTAL	148	100.0%	100.0%

FIG.34 CARIBOU GROUP SIZE, 1990 SEASON

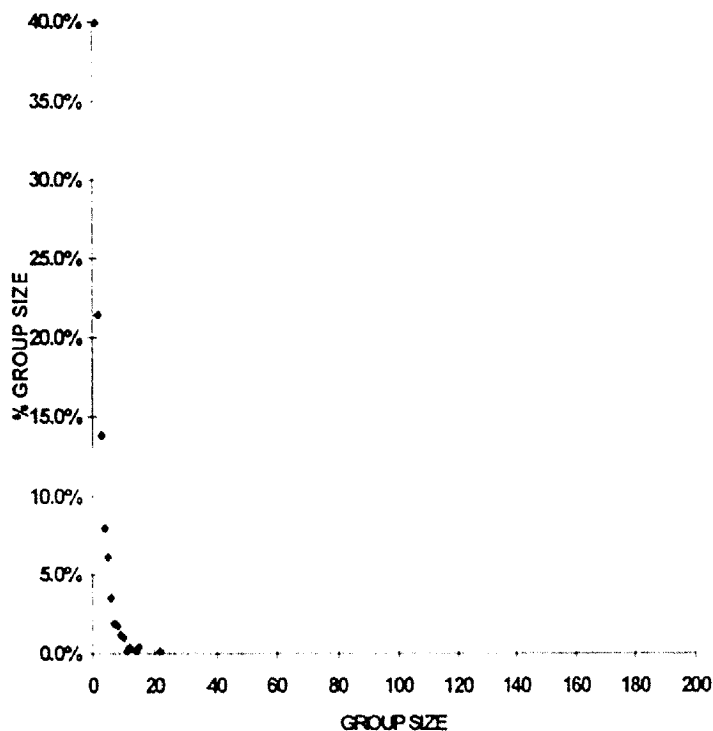


Table 25. Group size, number and percentage of stops for observation of caribou, May, 1991.

GROUP SIZE	NUMBER OF STOPS	% STOPS	% OBSERVATIONS BY GROUP SIZE
0	94	68.6%	other animals
1	8	5.8%	18.6%
2	7	5.1%	16.3%
3	8	5.8%	18.6%
4	3	2.2%	7.0%
5	6	4.4%	14.0%
6	4	2.9%	9.3%
7	1	0.7%	2.3%
8	2	1.5%	4.7%
9	2	1.5%	4.7%
10	1	0.7%	2.3%
13	1	0.7%	2.3%
TOTAL	137	100.0%	100.0%

Table 26. Group size, number and percentage of stops for observation of caribou, June, 1991.

GROUP SIZE	NUMBER OF STOPS	% STOPS	% OBSERVATIONS BY GROUP SIZE
0	406	58.7%	other animals
1	113	16.3%	39.5%
2	30	4.3%	10.5%
3	45	6.5%	15.7%
4	28	4.0%	9.8%
5	23	3.3%	8.0%
6	7	1.0%	2.4%
7	11	1.6%	3.8%
8	2	0.3%	0.7%
9	6	0.9%	2.1%
10	3	0.4%	1.0%
11	2	0.3%	0.7%
12	9	1.3%	3.1%
13	1	0.1%	0.3%
14	1	0.1%	0.3%
15	3	0.4%	1.0%
16	1	0.1%	0.3%
21	1	0.1%	0.3%
TOTAL	692	100.0%	100.0%

Table 27. Group size, number and percentage of stops for observation of caribou, July, 1991.

GROUP SIZE	NUMBER OF STOPS	% STOPS	% OBSERVATIONS BY GROUP SIZE
0	496	59.5%	other animals
1	152	18.2%	45.1%
2	57	6.8%	16.9%
3	35	4.2%	10.4%
4	16	1.9%	4.7%
5	23	2.8%	6.8%
6	11	1.3%	3.3%
7	12	1.4%	3.6%
8	7	0.8%	2.1%
9	7	0.8%	2.1%
10	2	0.2%	0.6%
11	2	0.2%	0.6%
12	1	0.1%	0.3%
13	1	0.1%	0.3%
14	1	0.1%	0.3%
15	4	0.5%	1.2%
16	2	0.2%	0.6%
20	1	0.1%	0.3%
22	1	0.1%	0.3%
23	1	0.1%	0.3%
40	1	0.1%	0.3%
TOTAL	833	100.0%	100.0%

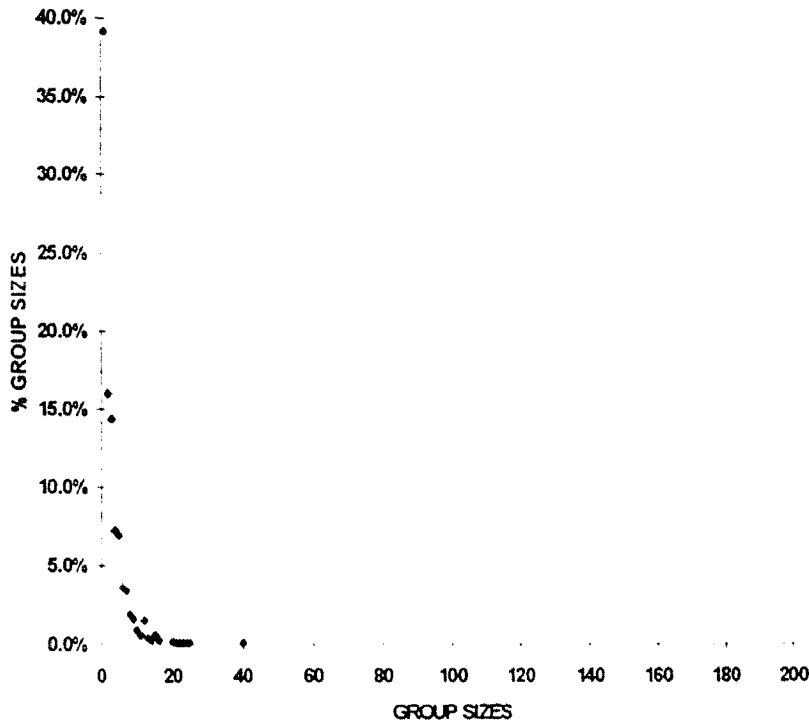
Table 28. Group size, number and percentage of stops for observation of caribou, August, 1991.

GROUP SIZE	NUMBER OF STOPS	% STOPS	% OBSERVATIONS BY GROUP SIZE
0	377	52.1%	other animals
1	123	17.0%	35.4%
2	70	9.7%	20.2%
3	57	7.9%	16.4%
4	26	3.6%	7.5%
5	18	2.5%	5.2%
6	16	2.2%	4.6%
7	10	1.4%	2.9%
8	9	1.2%	2.6%
9	2	0.3%	0.6%
10	4	0.6%	1.2%
11	2	0.3%	0.6%
12	5	0.7%	1.4%
13	1	0.1%	0.3%
14	1	0.1%	0.3%
20	1	0.1%	0.3%
24	1	0.1%	0.3%
25	1	0.1%	0.3%
TOTAL	724	100.0%	100.0%

Table 29. Group size, number and percentage of stops for observation of caribou, September, 1991.

GROUP SIZE	NUMBER OF STOPS	% STOPS	% OBSERVATIONS BY GROUP SIZE
0	85	78.7%	other animals
1	10	9.3%	43.5%
2	2	1.9%	8.7%
3	4	3.7%	17.4%
4	2	1.9%	8.7%
5	2	1.9%	8.7%
7	2	1.9%	8.7%
12	1	0.9%	4.3%
TOTAL	108	100.0%	100.0%

FIG. 35. CARIBOU GROUP SIZE, 1991 SEASON



Number of caribou calves per observation changed more through the season in 1988 and 1989 than the other 2 years (Figs. 36-39). On two occasions during 1988, ≥ 25 caribou calves were observed intermingled in groups of up to 60 animals. Calves numbering 5-9 animals per observation were relatively common throughout the seasons of 1988 and 1989 (Figs. 36 and 37). By contrast, no sightings of ≥ 2 calves per observation were made during 1990, and none > 1 calf per observation in 1991 (Figs. 38 and 39). Buses traveled, in 1990 and 1991, to mileposts where larger numbers of young were observed during 1988 and 1989 (Figs. 40-43). These data indicate that either cows with calves occupied areas of the park where they could not be observed from the road, and/or there was an apparent low reproductive success during the latter 2 years.

FIG. 36. NUMBER OF YOUNG CARIBOU PER OBSERVATION BY JULIAN DATE, 1988

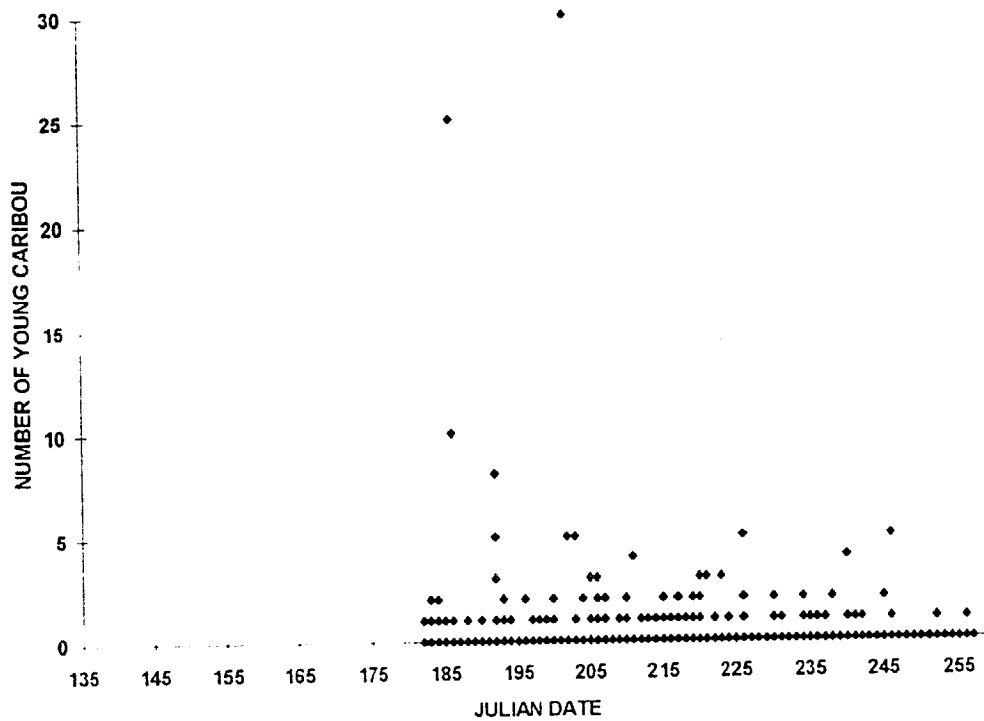


FIG. 37. NUMBER OF YOUNG CARIBOU PER OBSERVATION BY JULIAN DATE, 1989

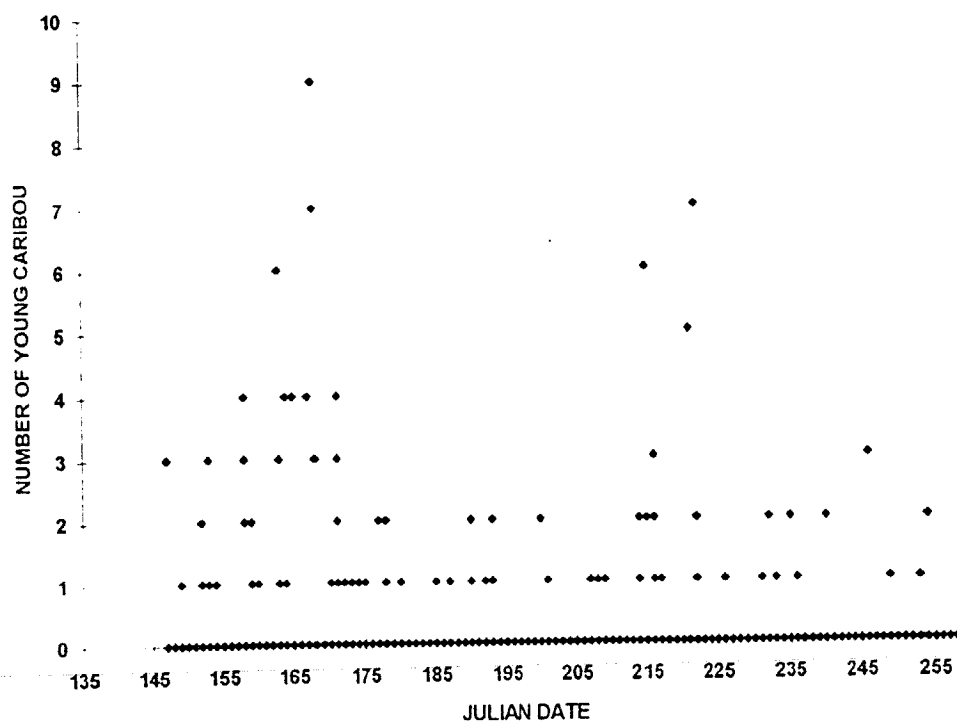


FIG.38. NUMBER OF YOUNG CARIBOU AND JULIAN DATE OF OBSERVATION, 1990

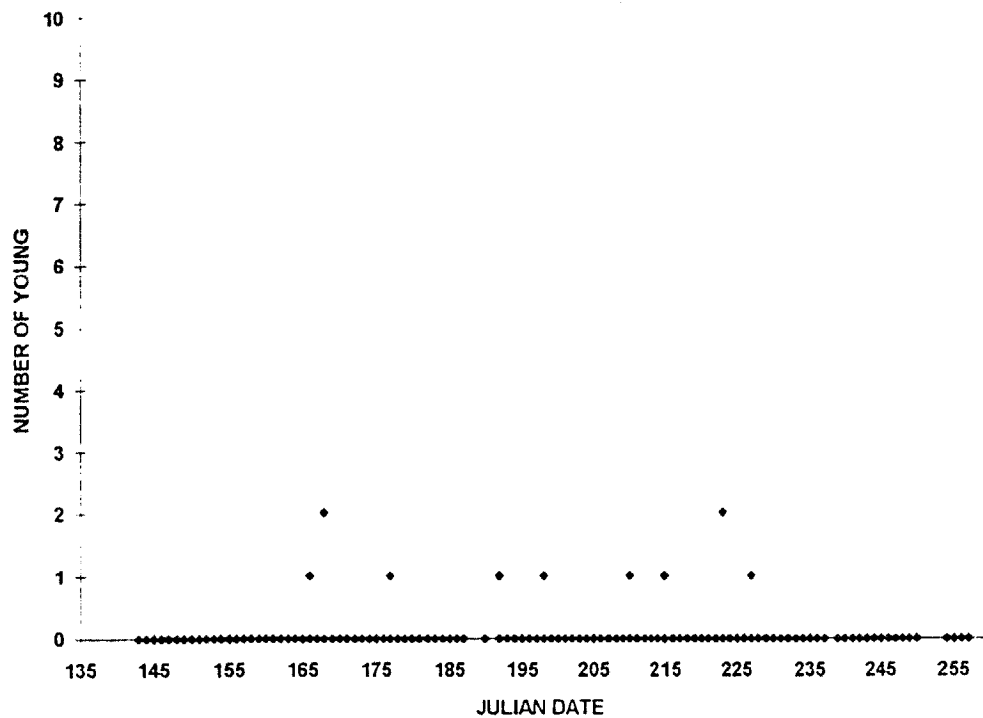
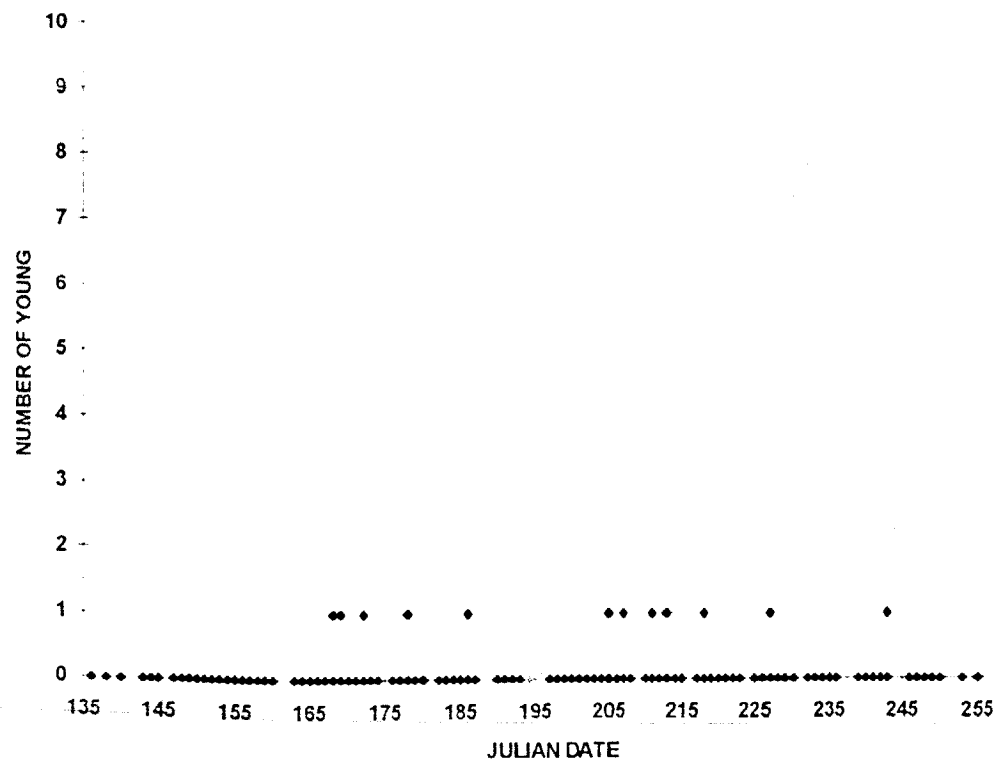


FIG. 39. NUMBER OF YOUNG CARIBOU PER OBSERVATION BY JULIAN DATE, 1991



Caribou calves were observed occasionally from milepost 0-35 (Figs. 40-43). They were observed most frequently from mileposts 40-70, especially in 1988 and 1989. Few caribou calves were observed at mileposts 70-87 in 1988 and 1989. Buses with observers did not travel past milepost 66 during 1990 and 1991.

FIG. 40. NUMBER OF YOUNG PER OBSERVATION, BY MILEPOST, 1988

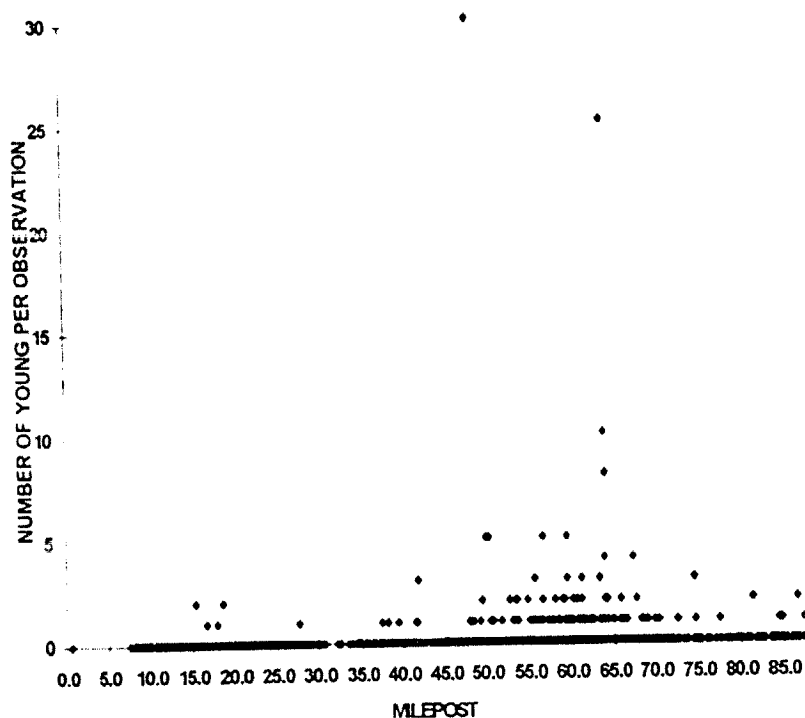


FIG. 41. NUMBER OF YOUNG CARIBOU BY MILEPOST, 1989

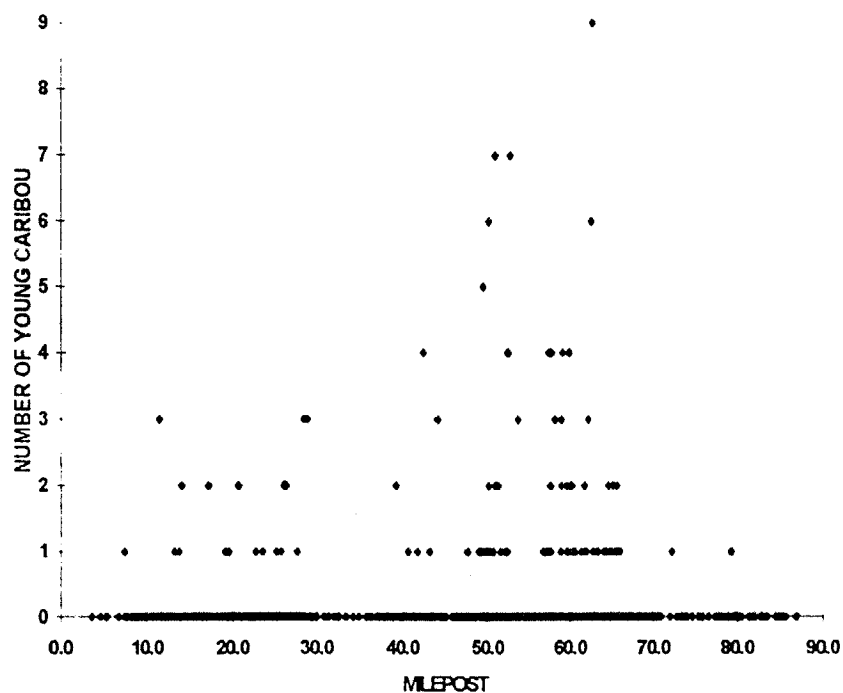


FIG. 42. NUMBER OF YOUNG CARIBOU PER OBSERVATION PER MILEPOST, 1990

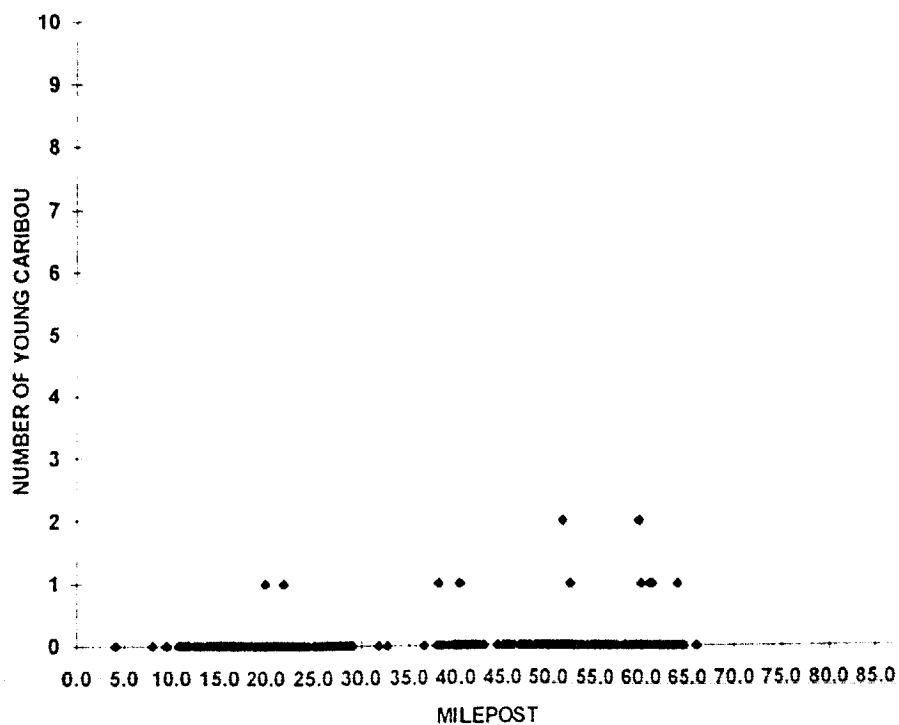
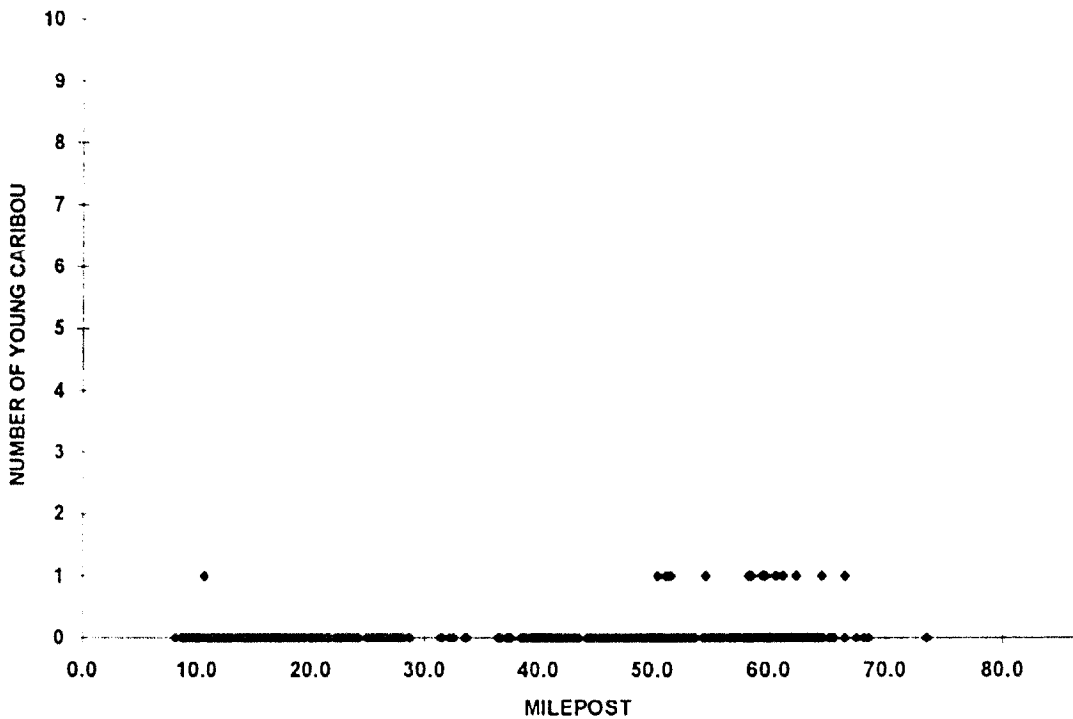


FIG. 43. NUMBER OF YOUNG CARIBOU PER OBSERVATION BY MILEPOST, 1991



The number of caribou calves per observation by hour the bus left for the day determined if the number of animals observed changed through the day (Figs. 44-47). A few observations of young were made when buses left from 0500 to 0800 hours in 1988, and 1989 (Figs. 44 and 45). The only time young were observed in 1990 was when buses left from 0500 to 0800 hours. Equal numbers of calves were observed in morning and afternoon during 1991 when few young caribou appeared in the sample.

FIG. 44. NUMBER OF YOUNG CARIBOU PER OBSERVATION BY BUS START TIME, 1988

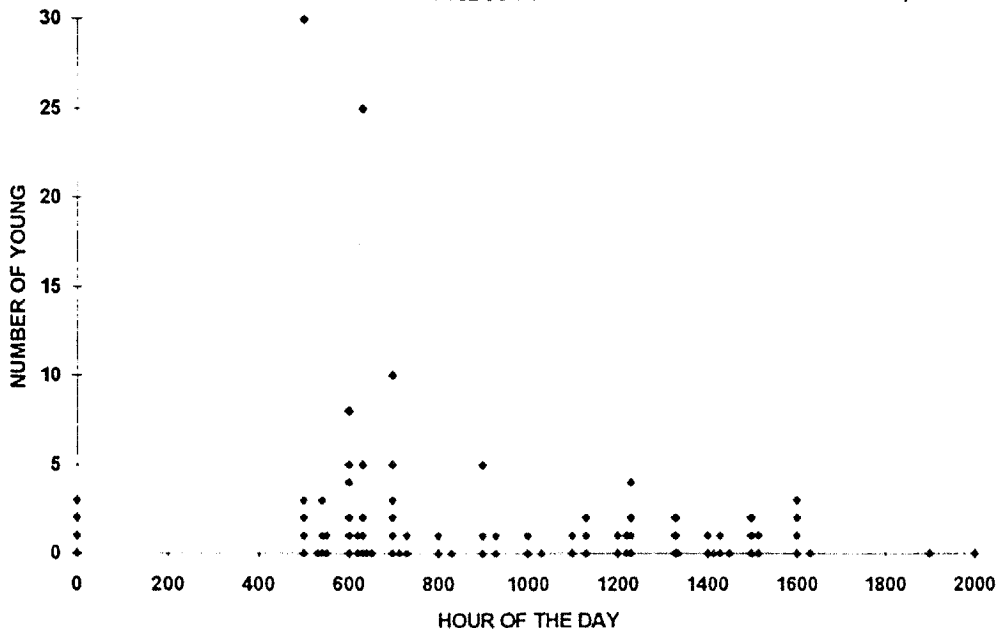


FIG. 45. NUMBER OF YOUNG PER OBSERVATION BY START TIME, 1989

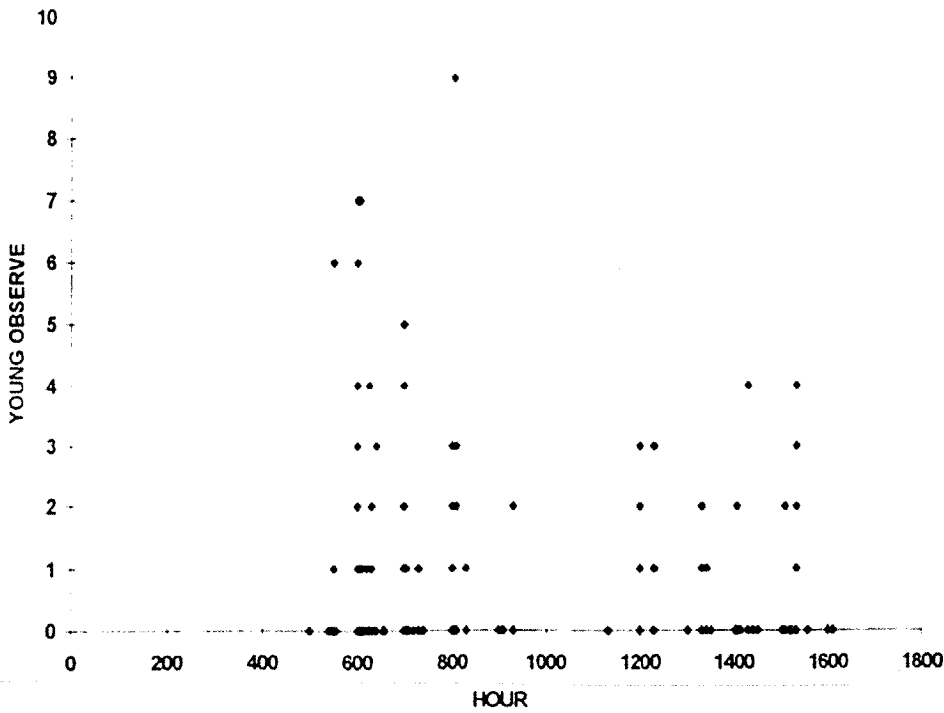


FIG. 46. NUMBER OF YOUNG CARIBOU PER OBSERVATION BY BUS START TIME, 1990

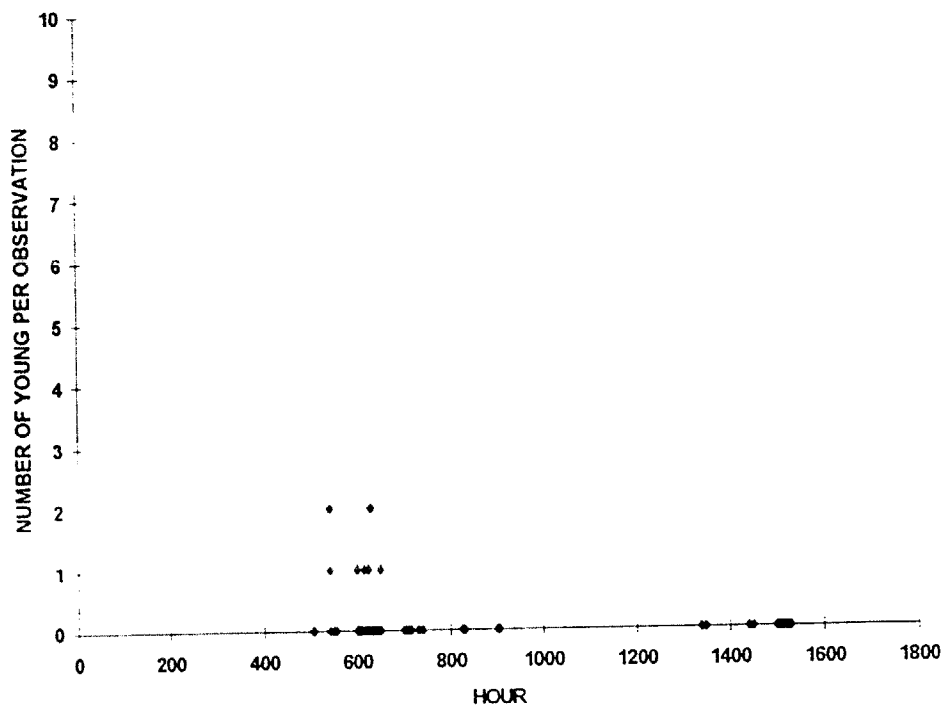
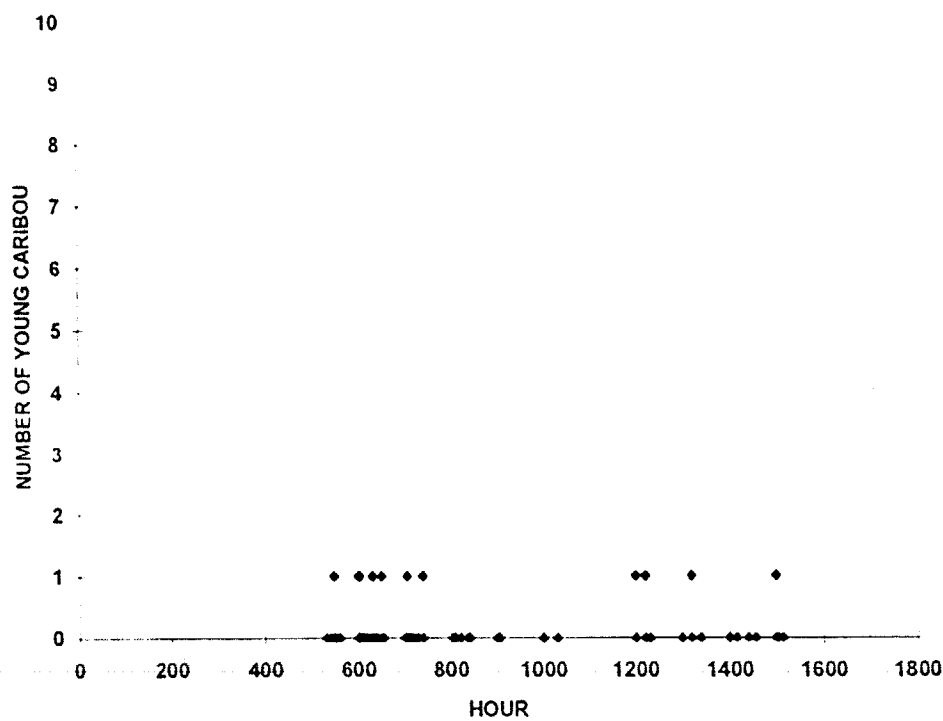
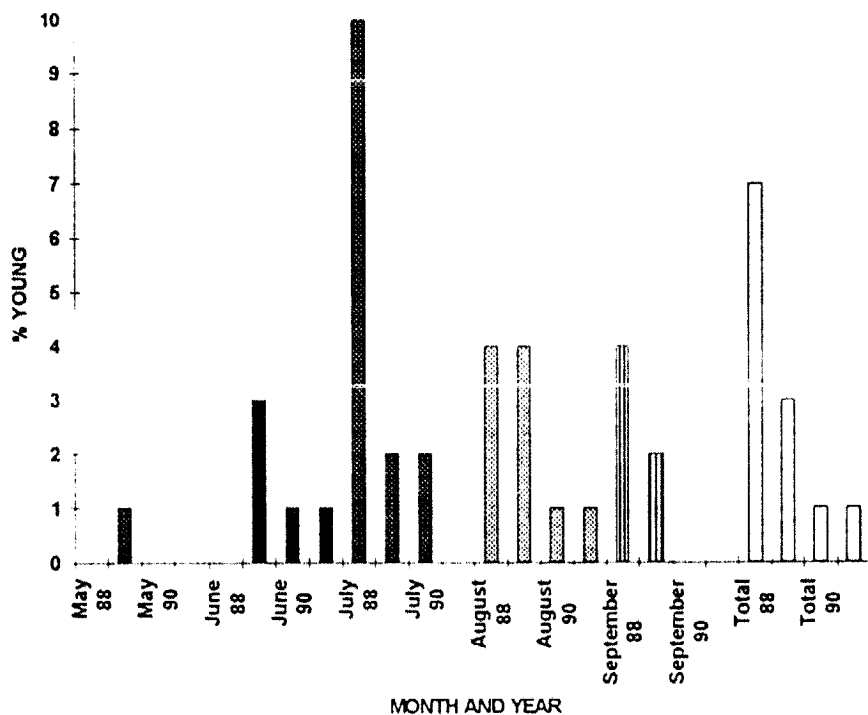


FIG. 47. NUMBER OF YOUNG CARIBOU PER OBSERVATION BY BUS START TIME, 1991



The percentage of total caribou that were calves changed by month and year (Fig. 48). The greatest percentage for any month was for July 1988 when approximately 10% of all caribou observed were young. No calves were observed during months of May 1990 and 1991, July 1991, and September 1990 and 1991.

Fig. 48. % TOTAL CARIBOU OBSERVED THAT WERE YOUNG, BY MONTH AND YEAR



Both adult and young caribou were recorded at elevations from about 2200 feet (670 m) to the maximum elevation of 4300 feet (1311 m) (Figs. 49 and 50). The largest groups of both adult and young caribou occurred above 3000 feet (914 m) elevation.

Fig. 49. Number of caribou per observation at elevation levels.

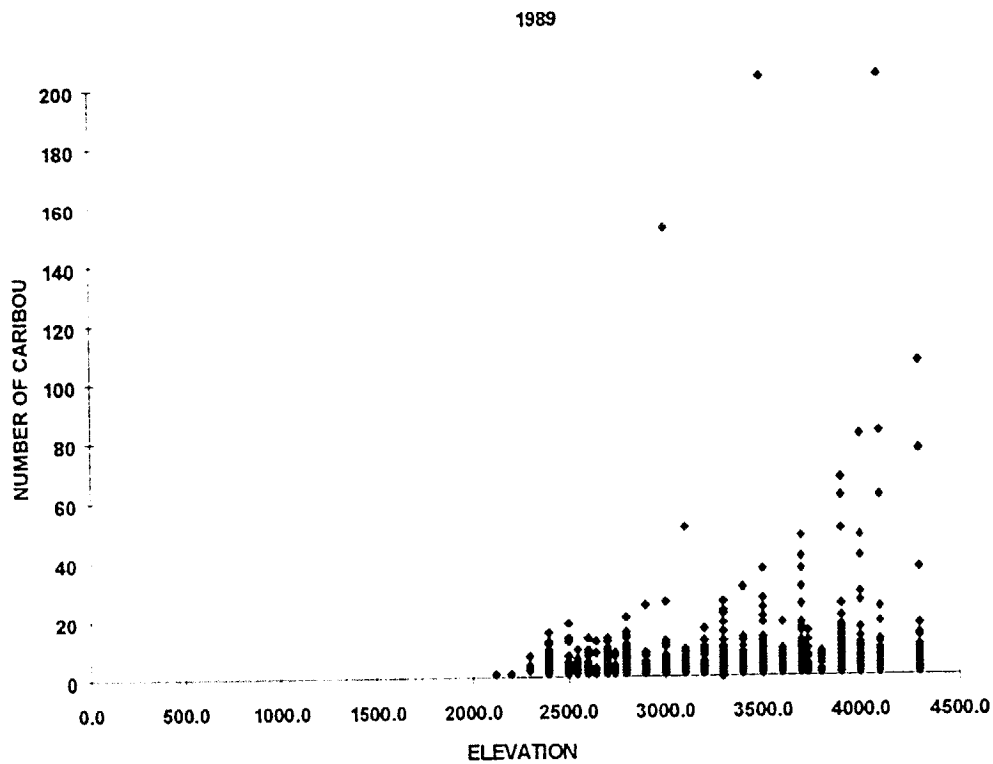


Fig. 50. The number of young caribou per observation at elevation

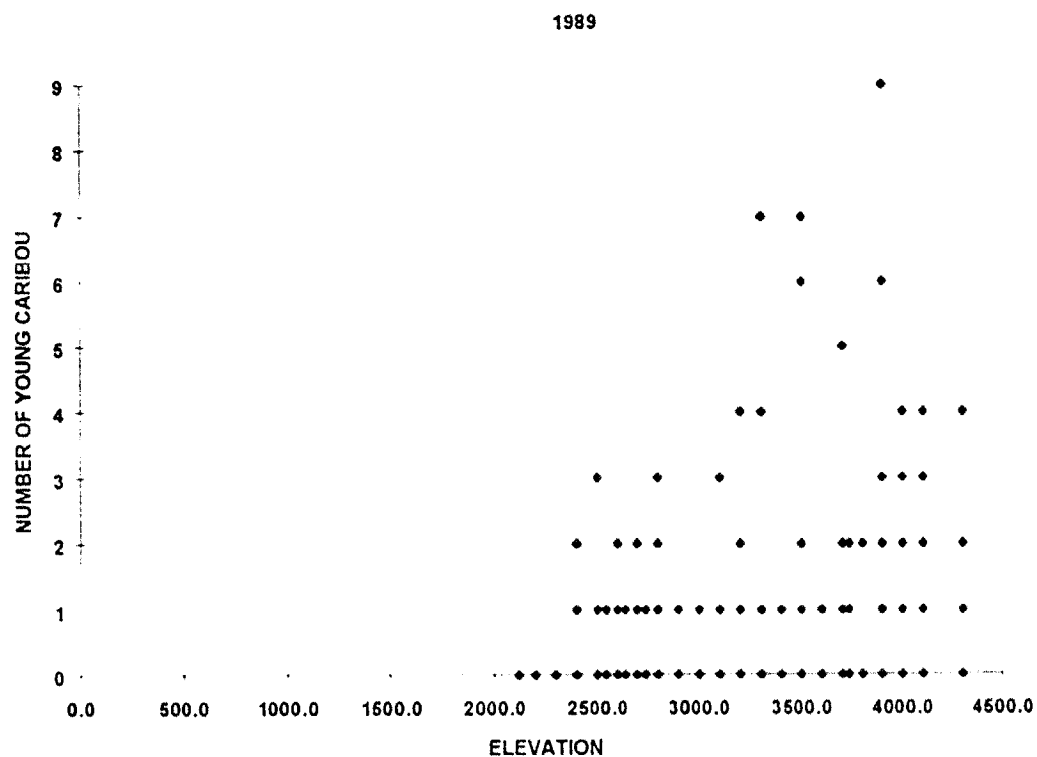
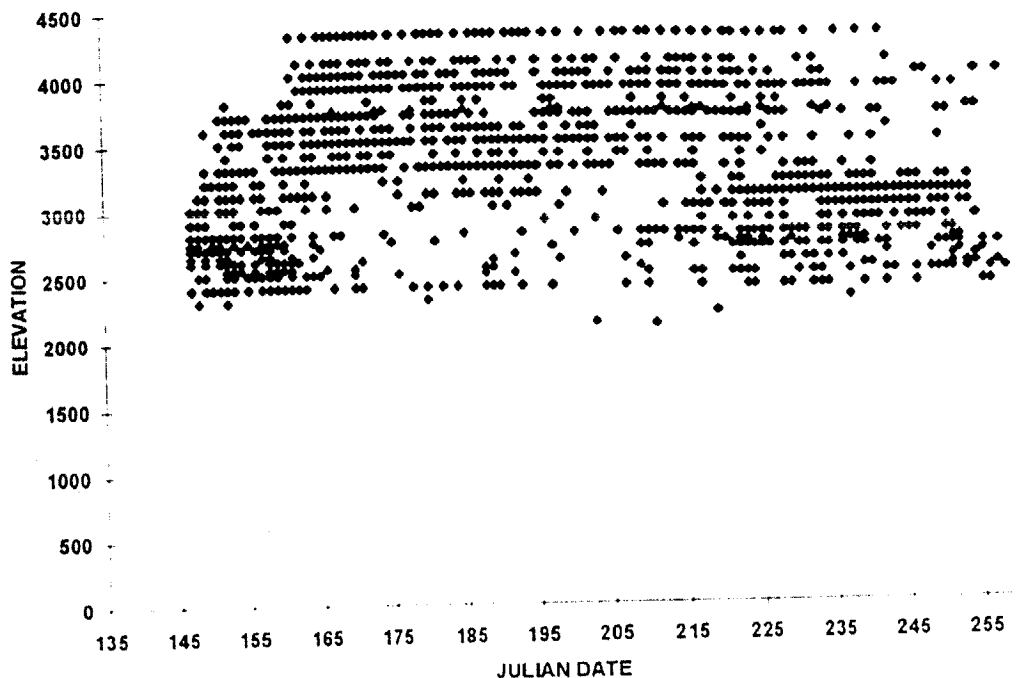


FIG. 51. JULIAN DATE CARIBOU WERE OBSERVED AT ELEVATION LEVELS



The number of caribou occurring at higher elevation increased from the end of May until mid-June (Fig. 51). From mid-June until early August, most caribou observations occurred above 3300 feet (1006 m) elevation. From early August until the end of the season, the greatest number of observations were of animals below 3200 feet (975 m) elevation.

Distances caribou were observed from the road were lumped into 14 categories: 0-on the road; 1-10 = 10 m intervals to 100 m; 11 = 100-200 m; 12 = 200-300 m; 13 = 300-400 m; and 14 = > 400 m interval (see Appendix 2).

No change in distance categories could be detected during the 4 years. No evident movement away from the road was detectable. All 4 years show fewer observations of caribou within the first 100 m category during the last 30 days of the season, probably an artifact of migration rather than a response to traffic (Figs. 52-55).

FIG. 52. DISTANCE CATEGORY OF EACH CARIBOU OBSERVATION BY JULIAN DATE , 1988

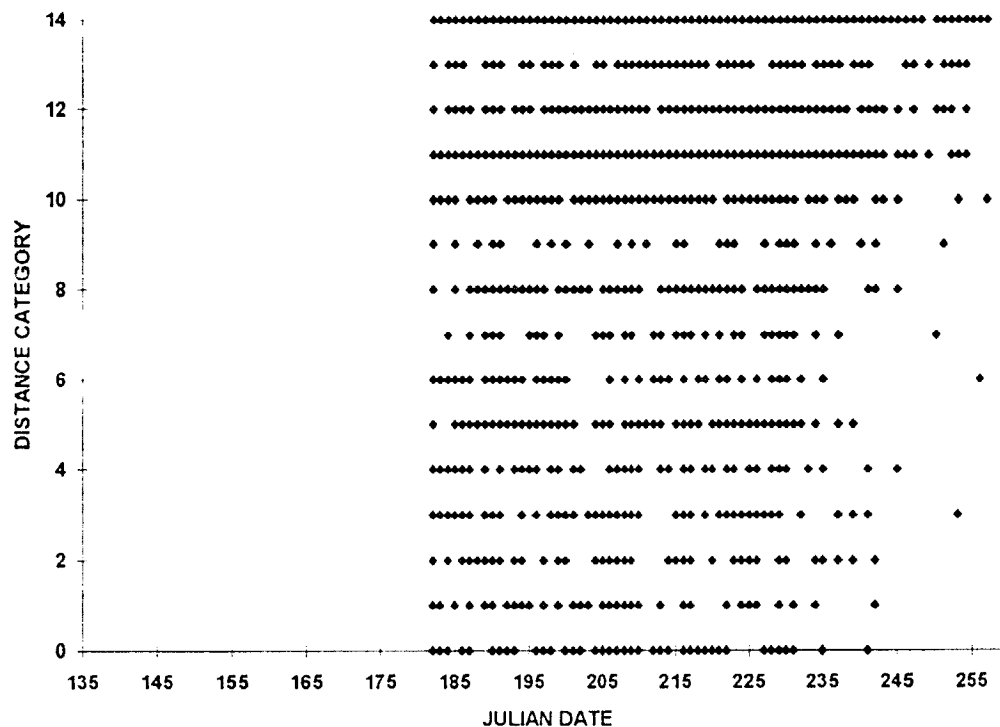


FIG. 53. DISTANCE CATEGORY OF EACH CARIBOU OBSERVATION BY JULIAN DATE,1989

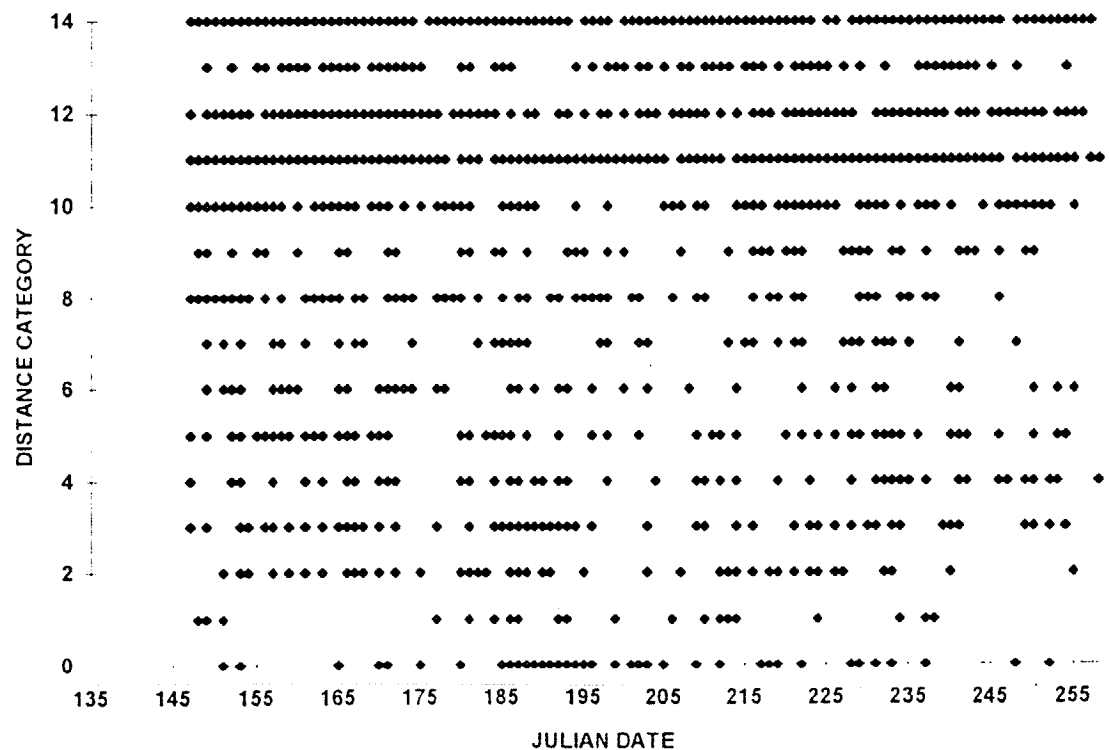


FIG. 54. DISTANCE CATEGORY OF EACH CARIBOU OBSERVATION BY JULIAN DATE, 1990

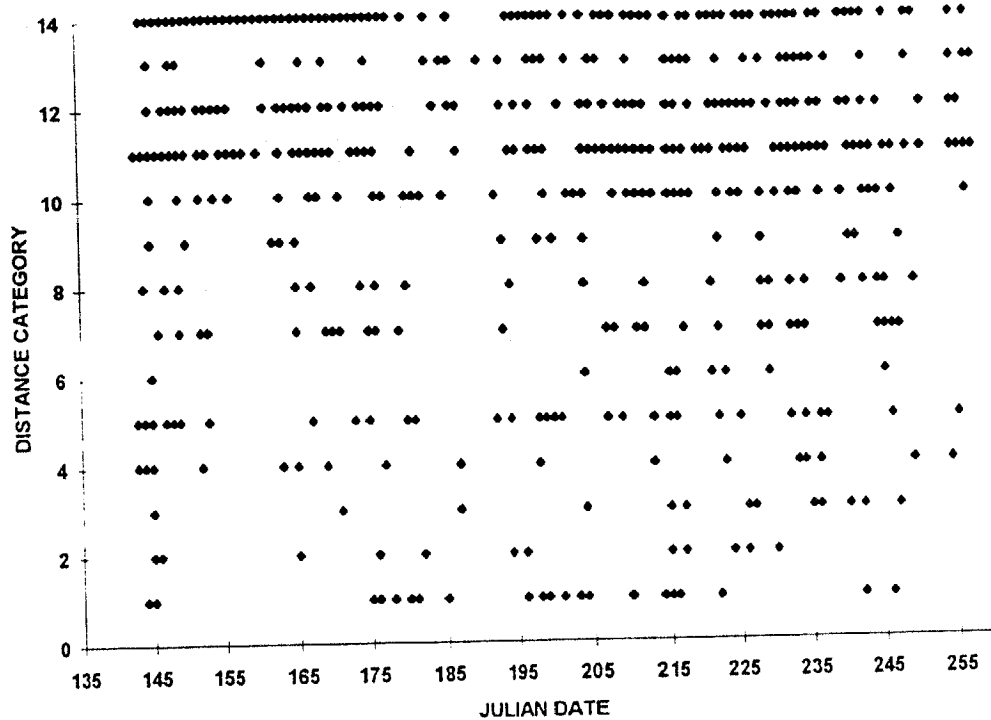
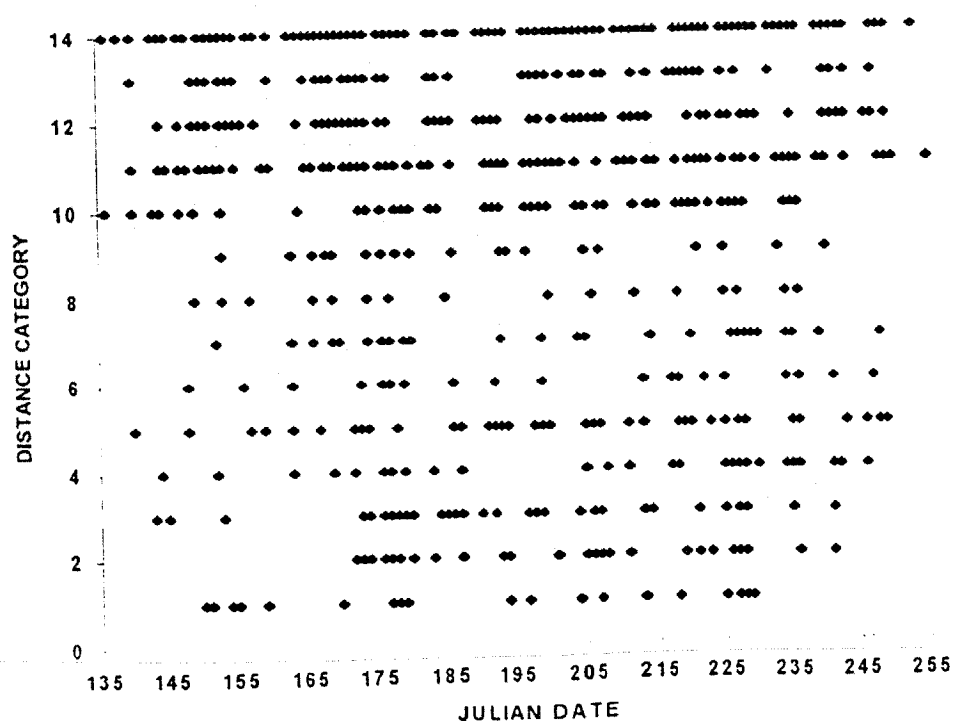


FIG. 55. DISTANCE CATEGORY AT EACH CARIBOU OBSERVATION BY JULIAN DATE, 1991



Hour of bus departure was plotted against distance category at which caribou were observed (Figs. 56-59). Caribou were observed as frequently in various distance categories by late afternoon departures as in early morning departures.

FIG. 56 DISTANCE CATEGORY OF CARIBOU OBSERVATIONS BY HOUR OF BUS DEPARTURE, 1988

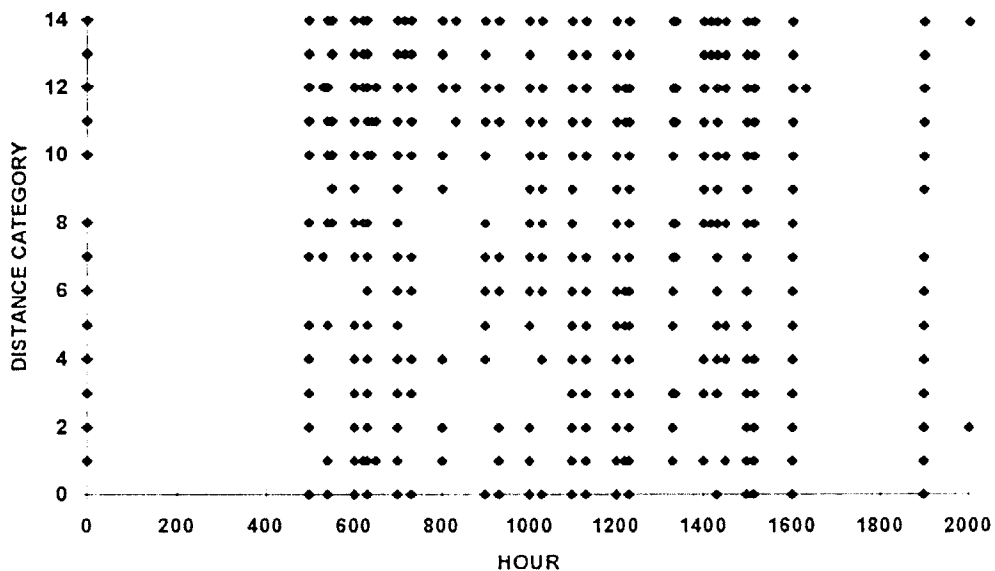


FIG. 57. DISTANCE CATEGORY OF CARIBOU OBSERVATIONS BY HOUR OF BUS DEPARTURE, 1989

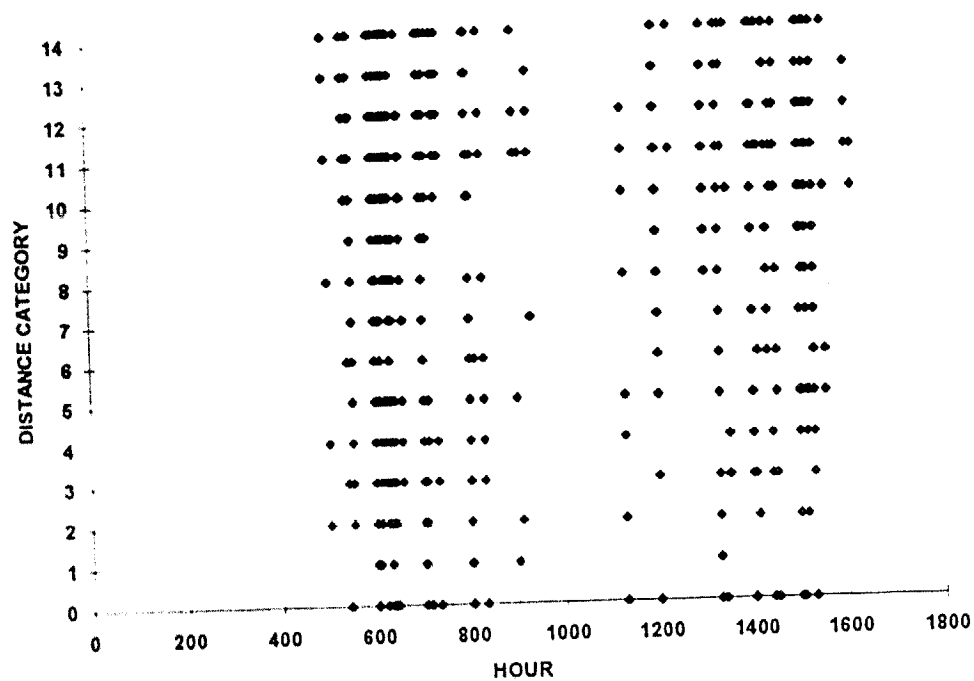


FIG. 58. DISTANCE CATEGORIES OF CARIBOU OBSERVATIONS BY HOUR OF THE DAY, 1990

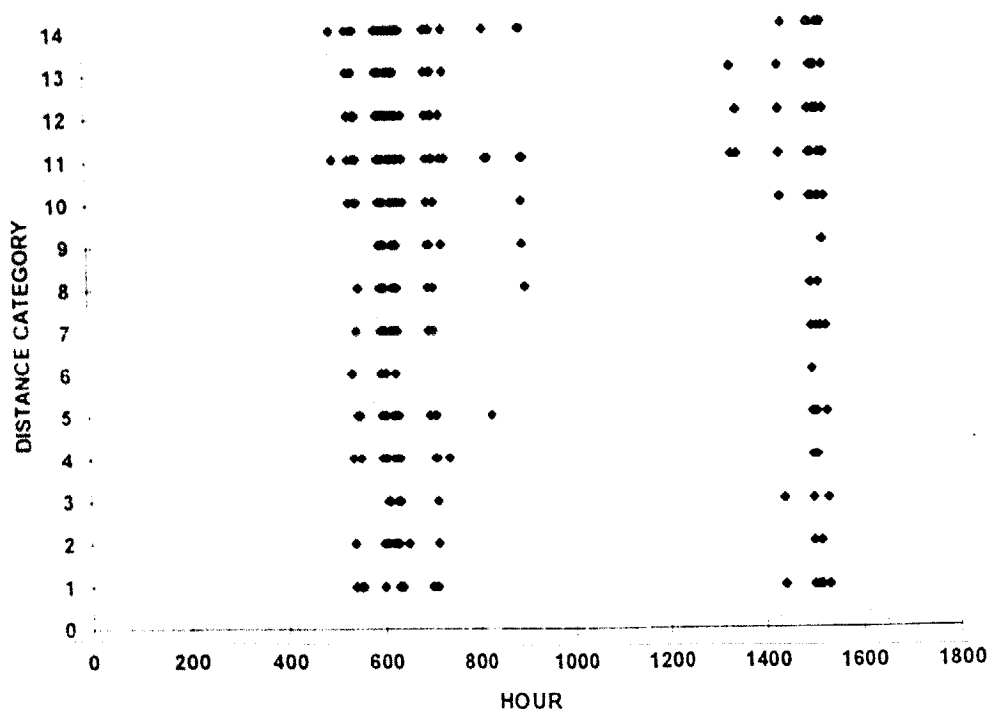
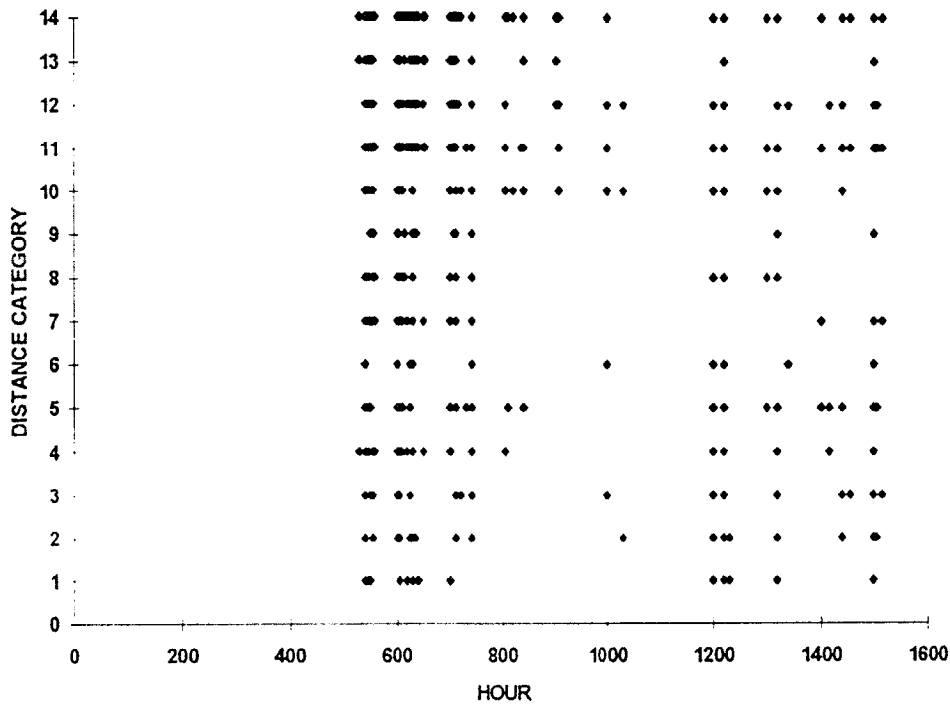


FIG. 59. DISTANCE CATEGORY OF CARIBOU OBSERVATIONS BY HOUR OF BUS
DEPARTURE, 1991



The percentage of observations by distance category shows a remarkable similarity from year to year (Figs.60-63). Percentages of observations within categories 0-10, i.e., at 10 m intervals to 100 m changed less than 1% between years. Observations within category 11-13, i.e., 100-200; 200-300; 300-400 m were within 5% between years. Category 14 showed a 10% change from 1990 to 1991, the greatest change of any category. These data suggest a relative stability of where caribou occur along the Denali road throughout the season.

FIG. 60. PER CENT OF CARIBOU OBSERVATIONS BY DISTANCE CATEGORY, 1988

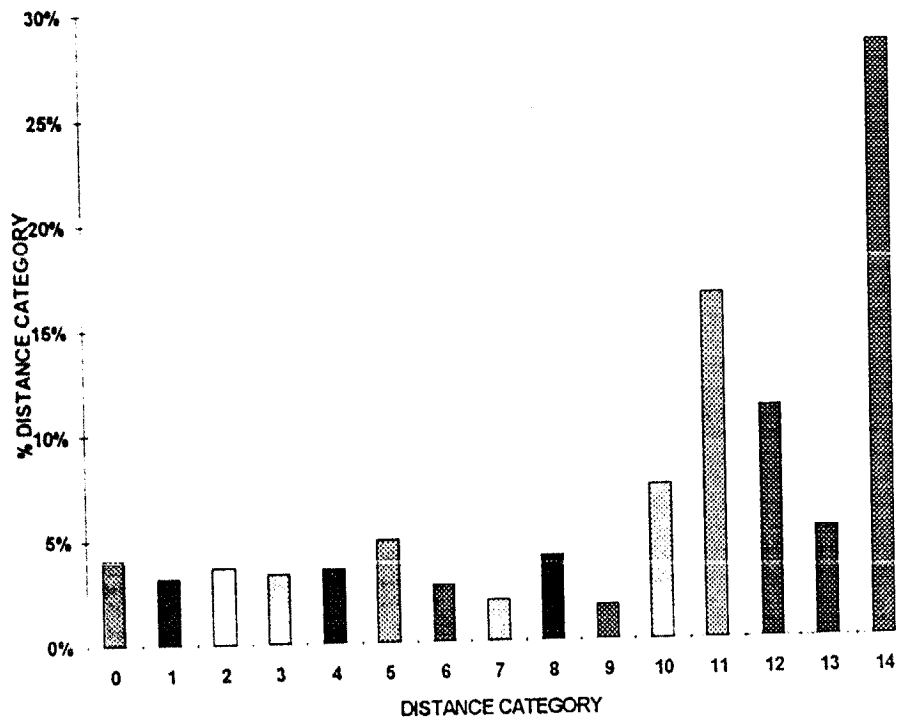


FIG. 61. PER CENT OF CARIBOU OBSERVATIONS BY DISTANCE CATEGORY, 1989

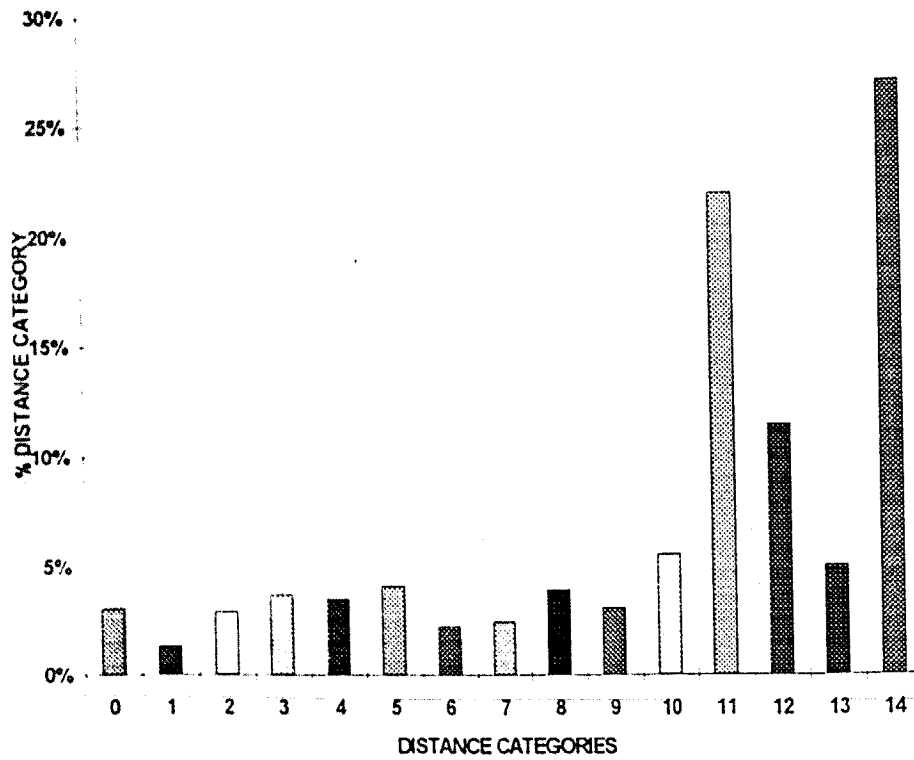


FIG. 62. PER CENT OF CARIBOU OBSERVATIONS BY DISTANCE CATEGORY, 1990

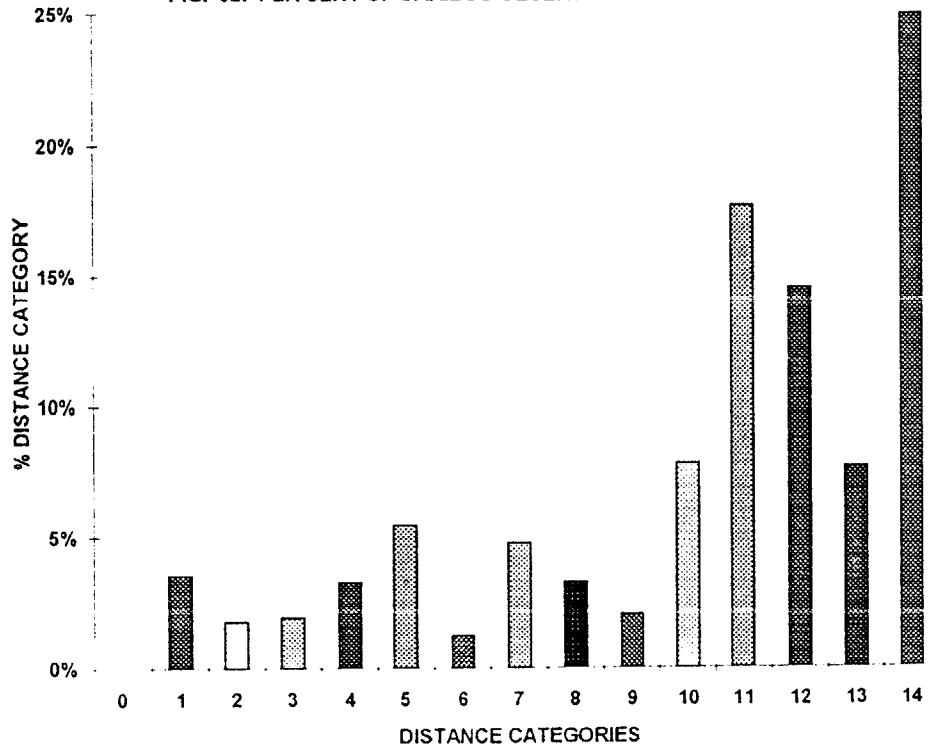


FIG. 63. PER CENT OF CARIBOU OBSERVATIONS BY DISTANCE CATEGORY, 1991

